Virginia Erosion & Sediment Control Field Manual

Second Edition
1995

Virginia Department of Environmental Quality

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

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INTRODUCTION

Regulatory authority for the Erosion & Sediment Control Program was transferred to the Department of Environmental Quality on July 1, 2013. Anywhere in the field manual where the Department of Conservation or DCR are referenced, the reference should be replaced; respectively, with the Department of Environmental Quality or DEQ. Additionally, anywhere Soil and Water Conservation Board or "Board" are reference in the handbook, the reference should be replaced with State Water Control Board.

This Virginia Erosion and Sediment Control Field Manual (Field Manual) is a supplement to the 1992 Virginia Erosion and Sediment Control Handbook (ESC Handbook). It was developed especially for individuals who are responsible for implementation of the Virginia Erosion and Sediment Control Program on construction projects in the field, such as local inspectors, job superintendents, foreman, and project managers.

This Field Manual contains information, extracted from the ESC Handbook, pertaining to the ESC specifications advocated by the state ESC program. **Section A** contains specific guidance for inspectors and responsible land disturbers, including a quick reference to the "19 Minimum Standards" of the state ESC program. **Section B** contains the description, construction details, and maintenance procedures for 28 structural and vegetative ESC specifications. Complete design criteria and considerations for each specification can be found in the ESC Handbook. Certain specifications that require special design and others that are seldom used have been omitted from this manual for ease of use.

Questions concerning this Field Manual or the state ESC Program in general may be directed to staff at the Department of Environmental Quality the following contact information:

Department of Environmental Quality
629 East Main St.
Richmond, VA 23219
(804) 698-4000

SECTION A

Guidance for Inspectors and Responsible Land Disturbers

Index

ROLE OF THE INSPECTOR

Each ESC program authority must have inspection and enforcement capabilities. Section 62.1-44.15:58 of the Virginia Erosion and Sediment Control Law (Law) states "either the permit-issuing or the plan-approving authority shall provide for periodic inspection of the land disturbing activity to ensure compliance with the approved plan." In some localities, this responsibility may be delegated to the building inspectors since they are most aware of construction activities within the jurisdiction and already inspect sites for compliance with the building and health codes. Some localities use Soil and Water Conservation District staff, utility inspectors, engineering staff, and/or other public employees.

Regardless who conducts inspections, the inspector needs to be aware of the objectives of the ESC program and their importance to its success. Without an effective inspection program, the plan-approving and permit-issuing elements of the program authority become ineffective. Soil is conserved and adjacent areas protected only through implementation of effective ESC specifications on the ground, and it is the inspector's job to ensure that such on site implementation takes place.

To be effective, an inspector must understand the technical and regulatory procedures and policies established by the Law, the Virginia Erosion and Sediment Control Regulations (Regulations), and the local ordinance. This current knowledge will allow the program administrator and inspector establish a system to properly implement these statutes.

The inspector must document each inspection in writing, whether or not a violation is found. If subsequent legal action is necessary to correct a violation, detailed and accurate documentation improves the chance of successful enforcement action. In addition, good documentation will help the inspector keep track and remain consistent with previous decisions and arguments he has made on past projects.

An easy way to maintain good documentation is to keep an inspection log. An inspection log is simply a continuous personal record of observations and decisions made during each inspection. The log can be kept in chronological order in a bound notebook, or on individual log sheets that can be filed in the appropriate project file. See page A-4 for an example log.

In addition to log entries, a more formal inspection report should be completed for all on site inspections. Such a report should describe the site conditions, any problems or violations of state Minimum Standards, and required corrective actions. The developer and other appropriate parties should receive a copy of inspection reports to facilitate expedited action on site. See page A-5 for an example report.

Further, one of the best forms of documentation is a photograph. Standard 35 mm photos, digital photos, or videos all will be helpful to clearly document on site conditions. Very often enforcement action takes long enough that the situation in the field can completely change by the time a case is finalized. Photographs of on and off site violations and resultant damages will make enforcement action more effective. It is an especially good idea to get photographs before construction begins of environmentally sensitive areas such as off site ponds, streams, and private properties. A visual comparison of before and after conditions will further strengthen enforcement cases.

In summary, a combination of ESC program knowledge and maintenance of appropriate documentation will greatly enhance local compliance and program effectiveness.

INSPECTOR'S DAILY LOG ENTRY

Date:_____

Time:_____

Project:

Stage of Project:

Condition of Site:

Verbal Comments (Violations, potential problems, etc.,):

Initialed_____

1995

INSPECTION REPORT

Project Name: _____ File No.

Insp. Date:_____ Time _____ Inspected By:

STAGE OF CONSTRUCTION

- o Pre-Construction Conference
- o Finish Grading
- o Building Construction
- O Rough Grading
- O Clearing and Grubbing
- O Final Stabilization

* State Regulation (section)	✔if repeat violation	Problem location & description	Corrective action required (skip a line between items)

***Refers to applicable regulation found in the most recent publication of the **Virginia Erosion and Sediment Control Regulations**

Verbal/Written Notification Given To:

Completion Deadline:_____

Report Prepared By: _____

Date:

ROLE OF THE RESPONSIBLE LAND DISTURBER

In accordance with 2001 revisions to the Law, all construction projects must designate a "Responsible Land Disturber" (RLD) who has the primary responsibility for implementation of the approved ESC plan on site. The RLD likely be designated on the approved plan or permit. The RLD may be the plan designer, foreman, job superintendent, project manager, or other party designated for a specific land-disturbing activity. Note that there are no requirements for the RLD to be on site during the land-disturbing activity.

The RLD is probably the most important link in the chain of people who are involved in implementing the state ESC Program. This individual controls expenditure of funds and the allocation of manpower and resources to install ESC specifications on the ground. No matter how much planning or plan review has been undertaken prior to a project, there will likely be little intentional control of erosion and sedimentation unless the RLD see that plans are properly implemented on site. Despite other essential responsibilities, the RLD must place a high priority on ESC to ensure protection of public and private property and natural resources in accordance with the requirements of the State program.

To be effective, the RLD must become familiar with the requirements and operating procedures provided under the state and appropriate local program. The RLD should obtain any information, brochures, or manuals available from the regulatory authorities. The primary source of information about the statewide ESC program is the ESC Handbook. The ESC Handbook is available from the Virginia Department of Environmental Quality. Each locality also has its own adopted ordinance and set of administrative procedures to implement their program. These documents should be available from the local program in which the project is undertaken.

APPLICATION OF MINIMUM STANDARDS

In addition to the approved ESC plan, the project inspector and the responsible land disturber should always have a copy of the "Minimum Standards" on the site. Minimum Standards (MS-) are minimum state requirements included in the Regulations for controlling erosion and sedimentation on all projects involving a regulated land-disturbing activity.

Applicable Minimum Standards must be satisfied in each approved ESC plan, unless the plan-approving authority grants a variance for a specific standard. Therefore, inspectors and persons responsible for carrying out approved plans must be aware of the Minimum Standards as well as the ESC specifications and other provisions of the approved plan themselves. These standards can be found in their entirety in the Regulations, which are part of Chapter 8 of the ESC Handbook.

For the sake of brevity and efficiency, a checklist that depicts each of the 19 Minimum Standards is included on pages A-8 and A-9. The use of this quick reference by inspectors and responsible land disturbers will help to ensure that plans and projects are in compliance with the state ESC Program.

The Law does allow bcalities to adopt standards that are more stringent than the state minimum. Although most localities have adopted the Minimum Standards without change, it is recommended that RLD check with the local program to confirm if there are any special local requirements that go beyond the Minimum Standards.

EROSION AND SEDIMENT CONTROL SPECIFICATIONS

The Minimum Standards should serve as a guide in choosing and implementing appropriate ESC specifications and techniques on site. The ESC Handbook describes 39 specifications used in Virginia. The specification description, construction details, and maintenance procedures for 28 of these techniques are most commonly used are contained **in Section B** of this Field Manual. Section B is organized by specification type (i.e., grass establishment, dikes and diversions).

Other innovative ESC specifications or modifications to the state-specified techniques may be used and are encouraged to enhance protection. However, such practices must be thoroughly detailed and approved by the plan-approving authority.

MINIMUM STANDARDS
"QUICK REFERENCE" CHECKLIST

Project Name:_____ File No._____

Inspection Date:_____ Time:_____ Inspected by:_____

STAGE OF CONSTRUCTION

___Pre-Construction Conference ___Rough Grading

___Finish Grading ___Clearing and Grubbing

___Building Construction ___Final Stabilization

==========

CHECKLIST

Yes	No	NA		
[ ]	[ ]	[ ]	*MS-1	Have all denuded areas requiring temporary or permanent stabilization been stabilized? Seeded? yes/no Mulched? yes/no Graveled? yes/no
[ ]	[ ]	[ ]	MS-2	Are soil stockpiles adequately stabilized with seeding and/or controlled with sediment trapping measures?
[ ]	[ ]	[ ]	MS-3	Does permanent vegetation provide adequate stabilization?
[ ]	[ ]	[ ]	MS-4	Have sediment trapping facilities been constructed as a first step in LDA?
[ ]	[ ]	[ ]	MS-5	For perimeter sediment trapping measures, are earthen structures stabilized?
[ ]	[ ]	[ ]	MS-6	Are sediment basins installed where needed?

* Refers to the minimum standards of the Virginia Erosion and Sediment Control Regulations (VR 625-02-00).

CHECKLIST (continued)

Yes	No	NA		
[ ]	[ ]	[ ]	MS-7	Are finished cut and fill slopes adequately stabilized?
[ ]	[ ]	[ ]	MS-8&9	Are on-site channels and outlets adequately stabilized?
[ ]	[ ]	[ ]	MS-10	Do all operational storm sewer inlets have adequate inlet protection?
[ ]	[ ]	[ ]	MS-11	Are stormwater conveyance channels adequately stabilized with channel lining and/or outlet protection?
[ ]	[ ]	[ ]	MS-12	Is in-stream construction conducted using measures to minimize channel damage?
[ ]	[ ]	[ ]	MS-13	Are temporary stream crossings of non-erodible material installed where applicable?
[ ]	[ ]	[ ]	MS-14	Are all applicable federal, state, and local regulations pertaining to working in or crossing live watercourses met?
[ ]	[ ]	[ ]	MS-15	Is necessary restabilization of in-stream construction complete?
[ ]	[ ]	[ ]	MS-16	Are utility trenches stabilized properly?
[ ]	[ ]	[ ]	MS-17	Are soil and mud kept off public roadways at intersections with site access roads?
[ ]	[ ]	[ ]	MS-18	Have all temporary control structures that are no longer needed been removed? Have all control structure repairs and sediment removal been performed?
[ ]	[ ]	[ ]	MS-19	Are properties and waterways downstream from development adequately protected from erosion and sediment deposition due to increases in peak stormwater runoff?

SECTION B

State Minimum Standards and Specifications

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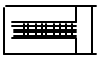
Erosion and Sediment Control Practices

Grass Establishment

Mulches

STD. & SPEC. 3.02
TEMPORARY STONE CONSTRUCTION ENTRANCE



CE

Practice Description

A stabilized stone pad with a filter fabric underliner located at points of vehicular ingress and egress on a construction site, used to reduce the amount of mud transported onto paved public roads by motor vehicles or runoff.

Conditions Where Practice Applies

Wherever traffic will be leaving a construction site and moves directly onto a public road or other paved area.

Construction Specifications

1. Aggregate Size: VDOT #1 Coarse Aggregate (2- to 3- inch stone) should be used.

2. Entrance Dimensions: The aggregate layer must be at least 6 inches thick; a minimum three inches of aggregate should be placed in a cut section to give the entrance added stability and to help secure filter cloth separator. It must extend the full width of the vehicular ingress and egress area and have a minimum 12-foot width. The length of the entrance must be at least 70 feet (see Plate 3.02-1).

3. Washing: If conditions on the site are such that the majority of the mud is not removed by the vehicles traveling over the stone, then the tires of the vehicles must be washed before entering the public road. Wash water must be carried away from the entrance to an approved settling area to remove sediment. All sediment shall be prevented from entering storm drains, ditches, or watercourses. A wash rack may also be used to make washing more convenient and effective (see Plate 3.02-1).

4. Location: The entrance should be located to provide for maximum utilization by all construction vehicles.

5. The area of the entrance must be excavated a minimum of 3 inches and must be cleared of all vegetation, roots, and other objectionable material. The filter fabric underliner will then be placed the full width and length of the entrance.

STONE CONST. ENTRANCE

6. Following the installation of the filter cloth, the stone shall be placed to the specified dimensions. If wash racks are used, they should be installed according to manufacturer's specifications. Any drainage facilities required because of washing should be constructed according to specifications. Conveyance of surface water under entrance, through culverts, shall be provided as required. If such conveyance is impossible, the construction of a "mountable" berm with 5:1 slopes will be permitted.

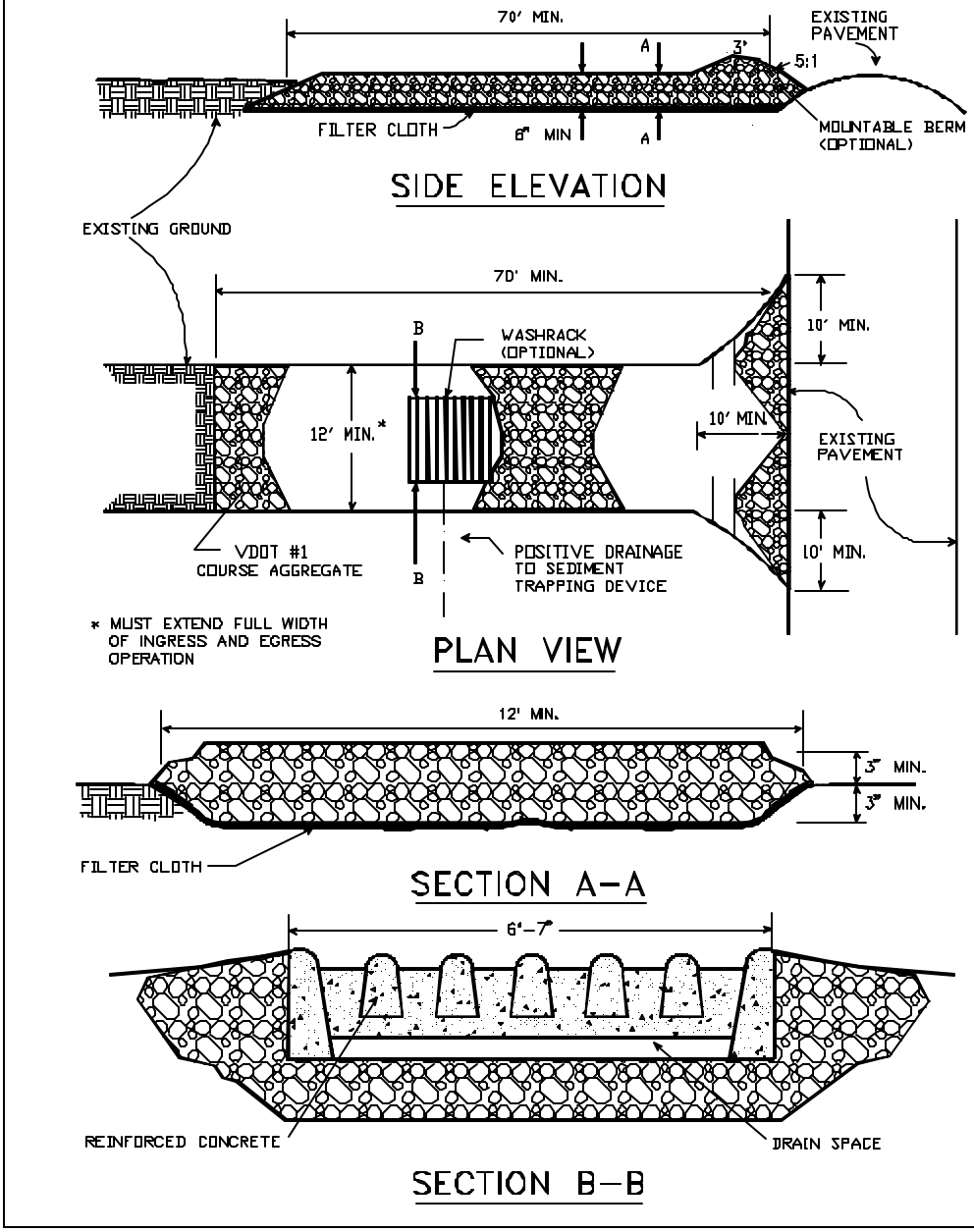
The filter cloth utilized shall be a woven or nonwoven fabric consisting only of continuous chain polymeric filaments or yarns of polyester. The fabric shall be inert to commonly encountered chemicals and hydrocarbons, be mildew and rot resistant, and conform to the physical properties noted in Table 3.02-A.

Maintenance

The entrance shall be maintained in a condition that will prevent tracking or flow of mud onto public rights-of-way. This may require periodic top dressing with additional stone or the washing and reworking of existing stone as conditions demand and repair and/or cleanout of any structures used to trap sediment. All materials spilled, dropped, washed, or tracked from vehicles onto roadways or into storm drains must be removed immediately. The use of water trucks to remove materials dropped, washed, or tracked onto roadways will not be permitted under any circumstances.

STONE CONST. ENTRANCE

STONE CONSTRUCTION ENTRANCE



SOURCE: ADAPTED from 1983 Maryland Standards for Soil erosion and Sediment Control, and Va. DSWC Plate 3.02-1

STONE CONST. ENTRANCE

TABLE 3.02-A
CONSTRUCTION SPECIFICATIONS
FOR FILTER CLOTH UNDERLINER

Fabric Properties[1]	Light-Duty Entrance[2] (Graded Subgrade)	Heavy Duty Entrance[3] (Rough Graded)	Test Method
Grab Tensile Strength (lbs.)	200	220	ASTM D1682
Elongation at Failure	50	220	ASTM D1682
Mullen Burst Strength (lbs)	190	430	ASTM D3786
Puncture Strength (lbs)	40	125	ASTM D751 (modified)
Equivalent Opening Size (mm)	40-80	40-80	U.S. Standard Sieve CW-02215

[1] Fabrics not meeting these specifications may be used only when design procedure and supporting documentation are supplied to determine aggregate depth and fabric strength.

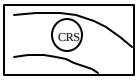
[2] Light Duty Entrance: Sites that have been graded to subgrade and where most travel would be single axle vehicles and an occasional multi-axle truck. Examples of fabrics which can be used are: Trevira Spunbound 1115, Mirafi 100X, Typar 3401, or equivalent.

[3] Heavy Duty Entrance: Sites with only rough grading and where most travel would be multi-axle vehicles. Examples of fabrics which can be used are: Trevira Spunbound 1135, Mirafi 600X, or equivalent.

Source: Virginia Highway & Transportation Research Council (VHTRC)

STONE CONST. ENTRANCE

STD & SPEC 3.03
CONSTRUCTION ROAD STABILIZATION



CRS

Practice Description

The temporary stabilization of access roads, subdivision roads, parking areas, and other on-site vehicle transportation routes with stone immediately after grading, to reduce the erosion of temporary roadbeds by construction traffic during wet weather, and to prevent having to regrade permanent roadbeds between the time of initial grading and final stabilization.

Conditions Where Practice Applies

Wherever stone-base roads or parking areas are constructed, whether permanent or temporary, for use by construction traffic.

Construction Specifications

Temporary Access Roads and Parking Areas

1. Temporary roads shall follow the contour of the natural terrain to the extent possible. Slopes should not exceed 10 percent.

2. Temporary parking areas should be located on naturally flat areas to minimize grading. Grades should be sufficient to provide drainage but should not exceed 4 percent.

3. Roadbeds shall be at least 14 feet wide for one-way traffic and 20 feet wide for two-way traffic.

4. All cuts and fills shall be 2:1 or flatter to the extent possible.

5. Drainage ditches shall be provided as needed and shall be designed and constructed in accordance with STORMWATER CONVEYANCE CHANNEL, Std. & Spec. 3.17.

6. The roadbed or parking surface shall be cleared of all vegetation, roots and other objectionable material.

7. A 6-inch course of VDOT #1 Coarse Aggregate shall be applied immediately after grading or the completion of utility installation within the right-of-way. Filter fabric may be applied to the roadbed for additional stability. Design specifications for filter fabric can be found within Std. & Spec. 3.02, TEMPORARY STONE CONSTRUCTION ENTRANCE. In "heavy duty" traffic situations (see Table 3.02-A), stone should be placed at an 8- to 10-inch depth to avoid excessive dissipation or maintenance needs.

Permanent Roads and Parking Areas

Permanent roads and parking areas shall be designed and constructed in accordance with applicable VDOT or local criteria except that an initial base course of gravel of at least 6 inches shall be applied immediately following grading.

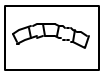
Vegetation

All roadside ditches, cuts, fills and disturbed areas adjacent to parking areas and roads shall be stabilized with appropriate temporary or permanent vegetation according to the applicable standards and specifications contained in this handbook.

Maintenance

Both temporary and permanent roads and parking areas may require periodic top dressing with new gravel. Seeded areas adjacent to the roads and parking areas should be checked periodically to ensure that a vigorous stand of vegetation is maintained. Roadside ditches and other drainage structures should be checked regularly to ensure that they do not become clogged with silt or other debris.

STD & SPEC 3.04
STRAW BALE BARRIER



STB

Practice Description

A temporary sediment barrier consisting of a row of entrenched and anchored straw bales; it is used to intercept and detain small amounts of sediment from disturbed areas of limited extent in order to prevent sediment from leaving the construction site and to decrease the velocity of sheet flows.

Conditions Where Practice Applies

1. Below disturbed areas subject to sheet and rill erosion.

2. Where the size of the drainage area is no greater than one-fourth of an acre per 100 feet of barrier length; the maximum slope length behind the barrier is 100 feet; and the maximum slope gradient behind the barrier is 50 percent (2:1).

3. Where effectiveness is required for less than 3 months.

4. Under no circumstances should straw bale barriers be constructed in live streams or in swales where there is the possibility of a washout.

5. The measure should not be used where water may concentrate in defined ditches and minor swales.

6. Straw bale barriers shall not be used on areas where rock or another hard surface prevents the full and uniform anchoring of the barrier.

Construction Specifications

Sheet Flow Application

1. Bales shall be placed in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another.

2. All bales shall be either wire-bound or string-tied. Straw bales shall be installed so that bindings are oriented around the sides rather than along the tops and bottoms of the bales in order to prevent deterioration of the bindings (see Plate 3.04-1).

3. The barrier shall be entrenched and backfilled. A trench shall be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 4 inches. After the bales are staked and chinked (gaps filled by wedging), the excavated soil shall be backfilled against the barrier. Backfill soil shall conform to the ground level on the downhill side and shall be built up to 4 inches against the uphill side of the barrier (see Plate 3.04-1).

4. Each bale shall be securely anchored by at least two stakes (minimum dimensions 2 inches x 2 inches x 36 inches) or standard "T" or "U" steel posts (minimum weight of 1.33 pounds per linear foot) driven through the bale. The first stake or steel post in each bale shall be driven toward the previously laid bale to force the bales together. Stakes or steel pickets shall be driven a minimum 18 inches deep into the ground to securely anchor the bales.

5. The gaps between bales shall be chinked (filled by wedging) with straw to prevent water from escaping between the bales. Loose straw scattered over the area immediately uphill from a straw bale barrier tends to increase barrier efficiency.

6. Inspection shall be frequent and repair or replacement shall be made promptly as needed.

7. Straw bale barriers shall be removed when they have served their usefulness, but not before the upslope areas have been permanently stabilized.

STRAW BALE BARRIER

Maintenance

1. Straw bale barriers shall be inspected immediately after each rainfall and at least daily during prolonged rainfall.

2. Close attention shall be paid to the repair of damaged bales, end runs and undercutting beneath bales.

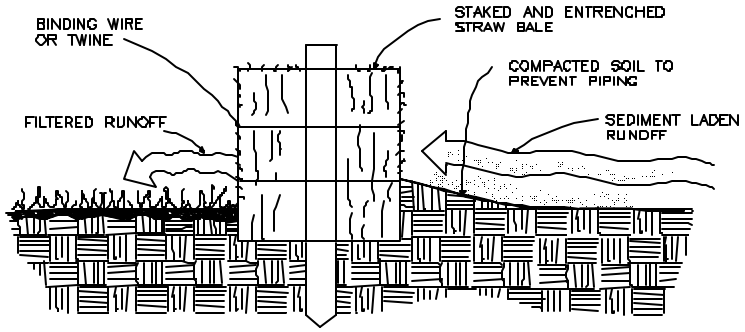
3. Necessary repairs to barriers or replacement of bales shall be accomplished promptly.

4. Sediment deposits should be removed after each rainfall. They must be removed when the level of deposition reaches approximately one-half the height of the barrier.

5. Any sediment deposits remaining in place after the straw bale barrier is no longer required shall be dressed to conform to the existing grade, prepared and seeded.

STRAW BALE BARRIER

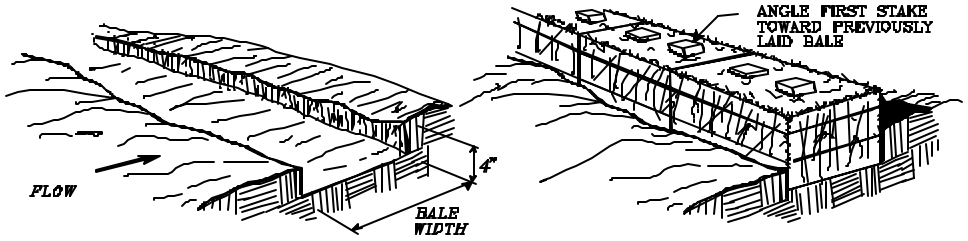
STRAW BALE BARRIER

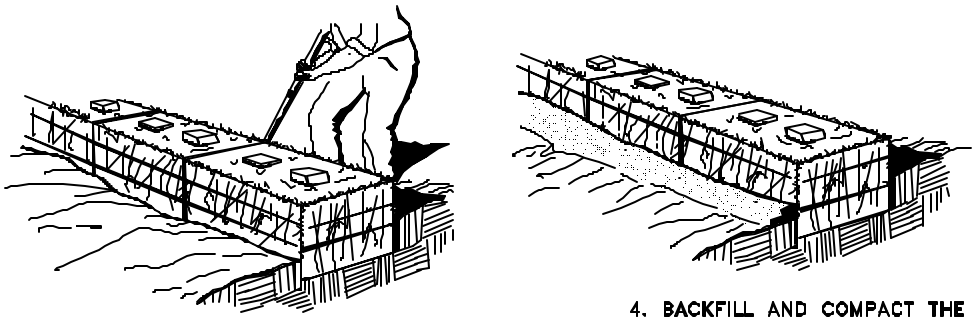


PROPERLY INSTALLED STRAW BALE
(CROSS SECTION)

1. EXCAVATE THE TRENCH.

2. PLACE AND STAKE STRAW BALES.





3. WEDGE LOOSE STRAW BETWEEN BALES.

4. BACKFILL AND COMPACT THE EXCAVATED SOIL.

CONSTRUCTION OF STRAW BALE BARRIER

SOURCE: VA. DSWC

PLATE. 3.04–1

STRAW BALE BARRIER

STD & SPEC. 3.05
SILT FENCE

SF

Practice Description

A temporary sediment barrier consisting of a synthetic filter fabric stretched across and attached to supporting posts and entrenched, used to intercept and detain small amounts of sediment from disturbed areas during construction operations in order to prevent sediment from leaving the site, and to decrease the velocity of sheet flows and low-to-moderate level channel flows.

Conditions Where Practice Applies

1. Below disturbed areas where erosion would occur in the form of sheet and rill erosion.

2. Where the size of the drainage area is no more than one quarter acre per 100 feet of silt fence length; the maximum slope length behind the barrier is 100 feet; and the maximum gradient behind the barrier is 50 percent (2:1).

3. In minor swales or ditch lines where the maximum contributing drainage area is no greater than 1 acre and flow is no greater than 1 cfs.

4. Silt fence will not be used in areas where rock or some other hard surface prevents the full and uniform depth anchoring of the barrier.

Construction Specifications

1. Synthetic filter fabric shall be a pervious sheet of propylene, nylon, polyester or ethylene yarn and shall be certified by the manufacturer or supplier as conforming to the requirements noted in Table 3.05-B.

TABLE 3.05-B
PHYSICAL PROPERTIES OF
FILTER FABRIC IN SILT FENCE

Physical Property	Test	Requirements
Filtering Efficiency	ASTM 5141	75% (minimum)
Tensile Strength at 20% (max.) Elongation*	VTM-52	Extra Strength- 50 lbs./linear inch (minimum) Standard Strength- 30 lbs./linear inch (minimum)
Flow Rate	ASTM 5141	0.2 gal./sq. ft./min. (minimum)
Ultraviolet Radiation	ASTM-G-26	90% (minimum)

*Requirements reduced by 50% after six months of installation.

Source: VHTRC

2. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 F to 120 F.

3. If wooden stakes are utilized for silt fence construction, they must have a diameter of 2 inches when oak is used and 4 inches when pine is used. Wooden stakes must have a minimum length of 5 feet.

4. If steel posts (standard "U" or "T" section) are utilized for silt fence construction, they must have a minimum weight of 1.33 pounds per linear foot and shall have a minimum length of 5 feet.

SILT FENCE

5. Wire fence reinforcement for silt fences using standard-strength filter cloth shall be a minimum of 14 gauge and shall have a maximum mesh spacing of 6 inches.

Installation

1. The height of a silt fence shall be a minimum of 16 inches above the original ground surface and shall not exceed 34 inches above ground elevation.

2. The filter fabric shall be purchased in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, filter cloth shall be spliced together only at a support post, with a minimum 6-inch overlap, and securely sealed.

3. A trench shall be excavated approximately 4-inches wide and 4-inches deep on the upslope side of the proposed location of the measure.

4. When wire support is used, standard-strength filter cloth may be used. Posts for this type of installation shall be placed a maximum of 10-feet apart (see Plate 3.05-1).

   The wire mesh fence must be fastened securely to the upslope side of the posts using heavy duty wire staples at least one inch long, tie wires or hog rings. The wire shall extend into the trench a minimum of two inches and shall not extend more than 34 inches above the original ground surface. The standard-strength fabric shall be stapled or wired to the wire fence, and 8 inches of the fabric shall be extended into the trench. The fabric shall not be stapled to existing trees.

5. When wire support is not used, extra-strength filter cloth shall be used. Posts for this type of fabric shall be placed a maximum of 6-feet apart (see Plate 3.05-2).

   The filter fabric shall be fastened securely to the upslope side of the posts using one inch long (minimum) heavy-duty wire staples or tie wires and eight inches of the fabric shall be extended into the trench. The fabric shall not be stapled to existing trees. This method of installation has been found to be more commonplace than #4.

SILT FENCE

6. If a silt fence is to be constructed across a ditch line or swale, the measure must be of sufficient length to eliminate endflow, and the plan configuration shall resemble an arc or horseshoe with the ends oriented upslope (see Plate 3.05-2). Extra-strength filter fabric shall be used for this application with a maximum 3-foot spacing of posts.

   All other installation requirements noted in #5 apply.

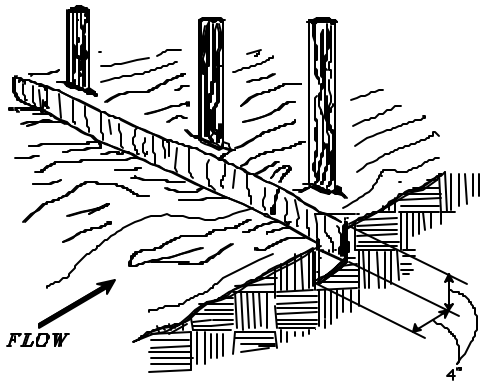
7. The 4-inch by 4-inch trench shall be backfilled and the soil compacted over the filter fabric.

8. Silt fences shall be removed when they have served their useful purpose, but not before the upslope area has been permanently stabilized.

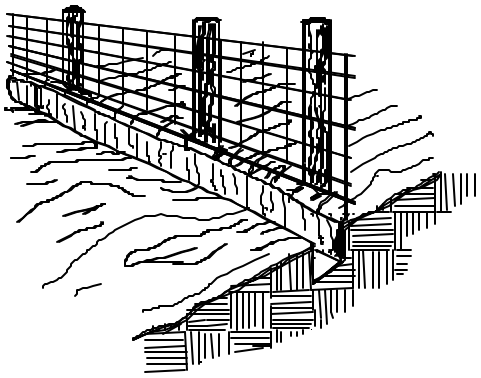
SILT FENCE

CONSTRUCTION OF A SILT FENCE (WITH WIRE SUPPORT)

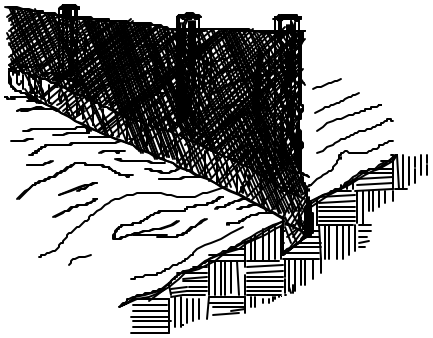
1. SET POSTS AND EXCAVATE A 4"X4" TRENCH UPSLOPE ALONG THE LINE OF POSTS.



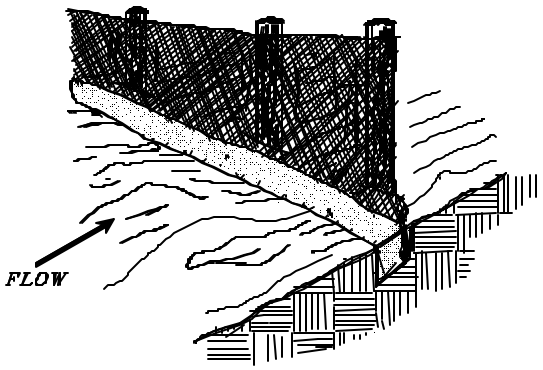
2. STAPLE WIRE FENCING TO THE POSTS.



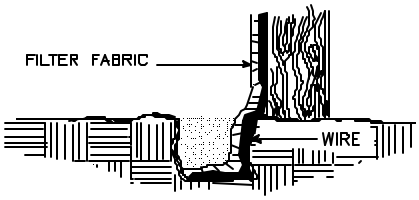
3. ATTACH THE FILTER FABRIC TO THE WIRE FENCE AND EXTEND IT INTO THE TRENCH.



4. BACKFILL AND COMPACT THE EXCAVATED SOIL.



EXTENSION OF FABRIC AND WIRE INTO THE TRENCH.



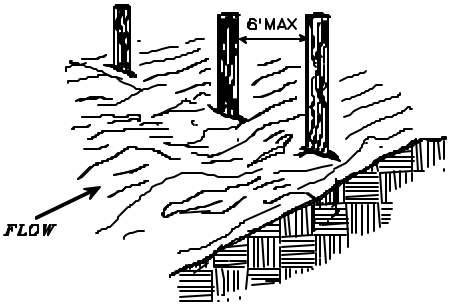
SOURCE: Adapted from Installation of Straw and Fabric Filter Barriers for Sediment Control, Sherwood & Wyant

PLATE 3.05-1

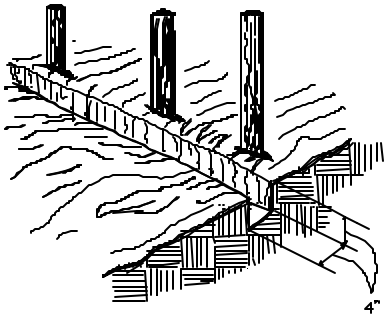
SILT FENCE

CONSTRUCTION OF A SILT FENCE (WITHOUT WIRE SUPPORT)

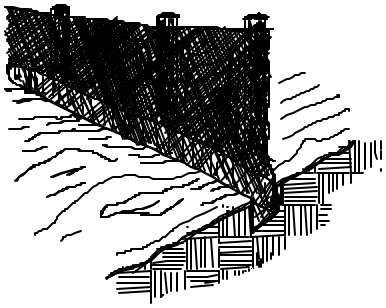
1. SET THE STAKES.



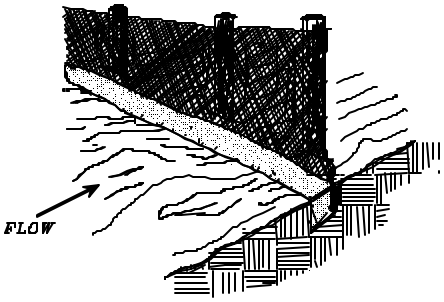
2. EXCAVATE A 4"X 4" TRENCH UPSLOPE ALONG THE LINE OF STAKES.



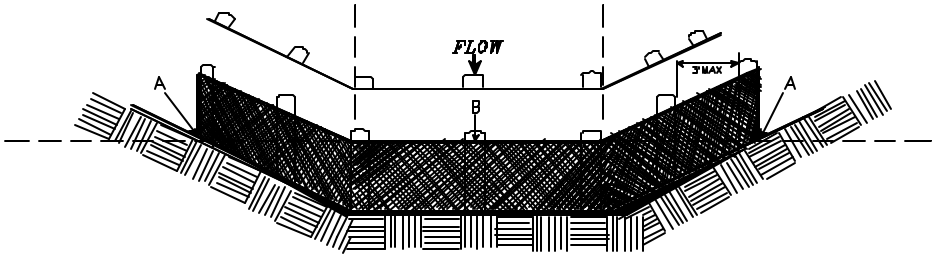
3. STAPLE FILTER MATERIAL TO STAKES AND EXTEND IT INTO THE TRENCH.



4. BACKFILL AND COMPACT THE EXCAVATED SOIL.



SHEET FLOW INSTALLATION
(PERSPECTIVE VIEW)



POINTS A SHOULD BE HIGHER THAN POINT B.

DRAINAGEWAY INSTALLATION
(FRONT ELEVATION)

SOURCE: Adapted from Installation of Straw and Fabric Filter Barriers for Sediment Control,VA. DSWC Sherwood and Vyant

PLATE. 3.05-2

SILT FENCE

Maintenance

1. Silt fences shall be inspected immediately after rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately.

2. Close attention shall be paid to the repair of damaged silt fence resulting from end runs and undercutting.

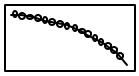
3. Should the fabric on a silt fence decompose or become ineffective prior to the end of the expected usable life and the barrier is still necessary, the fabric shall be replaced promptly.

4. Sediment deposits should be removed after each storm event. They must be removed when deposits reach approximately one-half the height of the barrier.

5. Any sediment deposits remaining in place after the silt fence is no longer required shall be dressed to conform with the existing grade, prepared and seeded.

SILT FENCE

STD & SPEC 3.06
BRUSH BARRIER



BB

Practice Description

A temporary sediment barrier constructed at the perimeter of a disturbed area from the residue materials available from clearing and grubbing the site, used to intercept and retain sediment from disturbed areas of limited extent, preventing sediment from leaving the site.

Conditions Where Practice Applies

1. Below disturbed areas subject to sheet and rill erosion, where enough residue material is available for construction of such a barrier.

2. Where the size of the drainage area is no greater than one-fourth of an acre per 100 feet of barrier length; the maximum slope length behind the barrier is 100 feet; and the maximum slope gradient behind the barrier is 50 percent (2:1).

Construction Specifications

Without Filter Cloth

1. The height of a brush barrier shall be a minimum of 3 feet.

2. The width of a brush barrier shall be a minimum of 5 feet at its base (the sizes of brush barriers may vary considerably based upon the amount of material available and the judgement of the design engineer).

3. The barrier shall be constructed by piling brush, stone, root mat and other material from the clearing process into a mounded row on the contour. Material larger than 6 inches in diameter should not be used to create the mound as the non-homogeneity of the mixture can lead to voids where sediment-laden flows can easily pass.

If a Filter Fabric is Used (see Plate 3.06-1)

1. Filter fabric must meet the minimum physical requirements noted in Table 3.05B.

2. The filter fabric shall be cut into lengths sufficient to lay across the barrier from its up-slope base to just beyond its peak. Where joints are necessary, the fabric shall be spliced together with a minimum 6-inch overlap and securely sealed.

3. A trench shall be excavated 6-inches wide and 4-inches deep along the length of the barrier and immediately uphill from the barrier.

4. The lengths of filter fabric shall be draped across the width of the barrier with the uphill edge placed in the trench and the edges of adjacent pieces overlapping each other.

5. The filter fabric shall be secured in the trench with stakes set approximately 36 inches on center.

6. The trench shall be backfilled and the soil compacted over the filter fabric.

7. Set stakes into the ground along the downhill edge of the brush barrier, and anchor the fabric by tying twine from the fabric to the stakes.

Maintenance

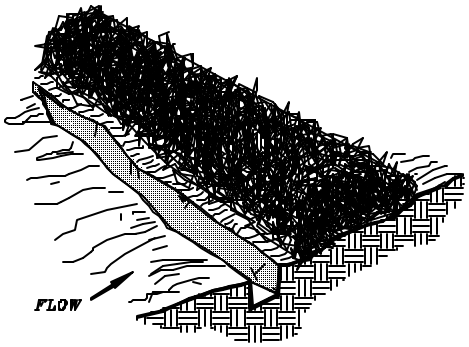
1. Brush barriers shall be inspected after each rainfall and necessary repairs shall be made promptly.

2. Sediment deposits must be removed when they reach approximately one-half the height of the barrier.

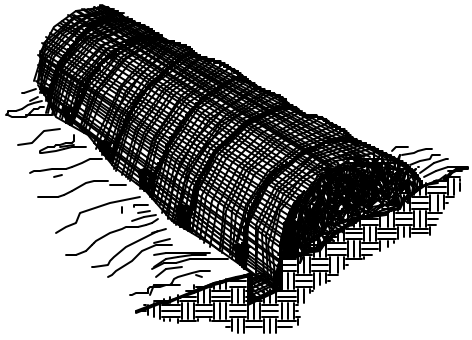
BRUSH BARRIER

CONSTRUCTION OF A BRUSH BARRIER COVERED BY FILTER FABRIC

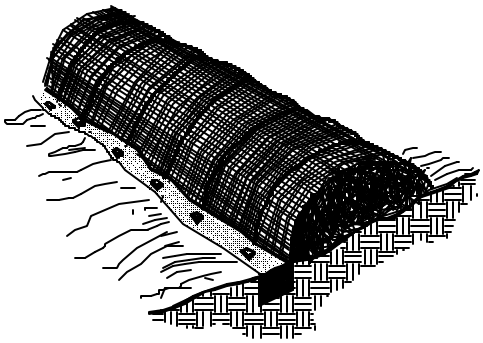
(TREE/RESIDUAL MATERIAL WITH DIAMETER > 6")



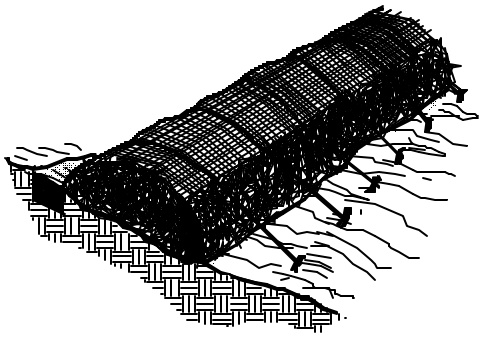
1. EXCAVATE A 4"X 4" TRENCH ALONG THE UPHILL EDGE OF THE BRUSH BARRIER.



2. DRAPE FILTER FABRIC OVER THE BRUSH BARRIER AND INTO THE TRENCH. FABRIC SHOULD BE SECURED IN THE TRENCH WITH STAKES SET APPROXIMATELY 36" O.C.



3. BACKFILL AND COMPACT THE EXCAVATED SOIL.

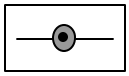


4. SET STAKES ALONG THE DOWN-HILL EDGE OF THE BRUSH BARRIER, AND ANCHOR BY TYING TWINE FROM THE FABRIC TO THE STAKES.

SOURCE: VA. DSWC PLATE. 3.06-1

BRUSH BARRIER

STD & SPEC 3.07
STORM DRAIN INLET PROTECTION



IP

Practice Description

A sediment filter or an excavated impounding area around a storm drain drop inlet or curb inlet used to prevent sediment from entering storm drainage systems prior to permanent stabilization of the disturbed area.

Conditions Where Practice Applies

Where storm drain inlets are to be made operational before permanent stabilization of the corresponding disturbed drainage area. Different types of structures are applicable to different conditions (see Plates 3.07-1 through 3.07-8).

Construction Specifications

1. Silt Fence Drop Inlet Protection

   a. Silt Fence shall conform to the construction specifications for "extra strength" found in Table 3.05-B and shall be cut from a continuous roll to avoid joints.

   b. For stakes, use 2 x 4-inch wood (preferred) or equivalent metal with a minimum length of 3 feet.

   c. Space stakes evenly around the perimeter of the inlet a maximum of 3-feet apart, and securely drive them into the ground, approximately 18-inches deep (see Plate 3.07-1).

   d. To provide needed stability to the installation, frame with 2 x 4-inch wood strips around the crest of the overflow area at a maximum of 1½feet above the drop inlet crest.

   e. Place the bottom 12 inches of the fabric in a trench Plate 3.07-1) and backfill the trench with 12 inches of compacted soil.

   f. Fasten fabric securely by staples or wire to the stakes and frame. Joints must be overlapped to the next stake.

   g. It may be necessary to build a temporary dike on the downslope side of the structure to prevent bypass flow.

2. Gravel and Wire Mesh Drop Inlet Sediment Filter

   a. Wire mesh shall be laid over the drop inlet so that the wire extends a minimum of 1 foot beyond each side of the inlet structure. Wire mesh with 1/2-inch openings shall be used. If more than one strip of mesh is necessary, the strips shall be overlapped.

   b. Coarse aggregate shall be placed over the wire mesh as indicated on Plate 3.07-2. The depth of stone shall be at least 12 inches over the entire inlet opening. The stone shall extend beyond the inlet opening at least 18 inches on all sides.

   c. If the stone filter becomes clogged with sediment so that it no longer adequately performs its function, the stones must be pulled away from the inlet, cleaned and/or replaced.

Note: This filtering device has no overflow mechanism; therefore, ponding is likely especially if sediment is not removed regularly. This type of device must never be used where overflow may endanger an exposed fill slope. Consideration should also be given to the possible effects of ponding on traffic movement, nearby structures, working areas, adjacent property, etc.

3. Block and Gravel Drop Inlet Sediment Filter

   a. Place concrete blocks lengthwise on their sides in a single row around the perimeter of the inlet, with the ends of adjacent blocks abutting. The height of the barrier can be varied, depending on design needs, by stacking combinations of 4-inch, 8-inch and 12-inch wide blocks. The barrier of blocks shall be at least 12-inches high and no greater than 24-inches high.

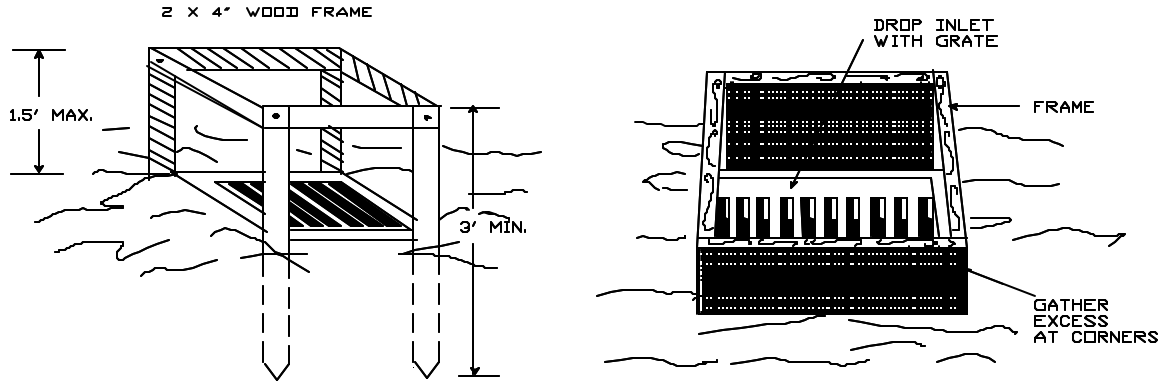
   b. Wire mesh shall be placed over the outside vertical face (webbing) of the concrete blocks to prevent stone from being washed through the holes in the blocks. Wire mesh with 1/2-inch openings shall be used.

   c. Stone shall be piled against the wire to the top of the block barrier, as shown in Plate 3.07-3.

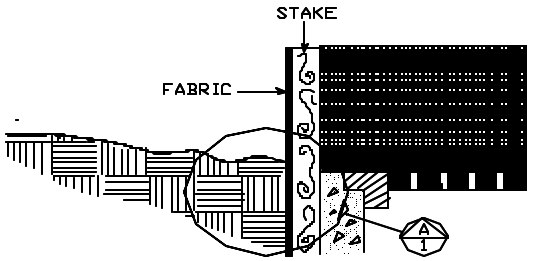
   d. If the stone filter becomes clogged with sediment so that it no longer adequately performs its function, the stone must be pulled away from the blocks, cleaned and replaced.

STORM DRAIN INLET PROTECTION

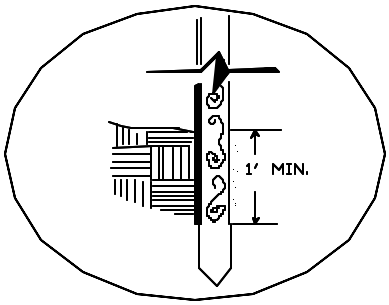
SILT FENCE DROP INLET PROTECTION



PERSPECTIVE VIEWS



ELEVATION OF STAKE AND FABRIC ORIENTATION



DETAIL A

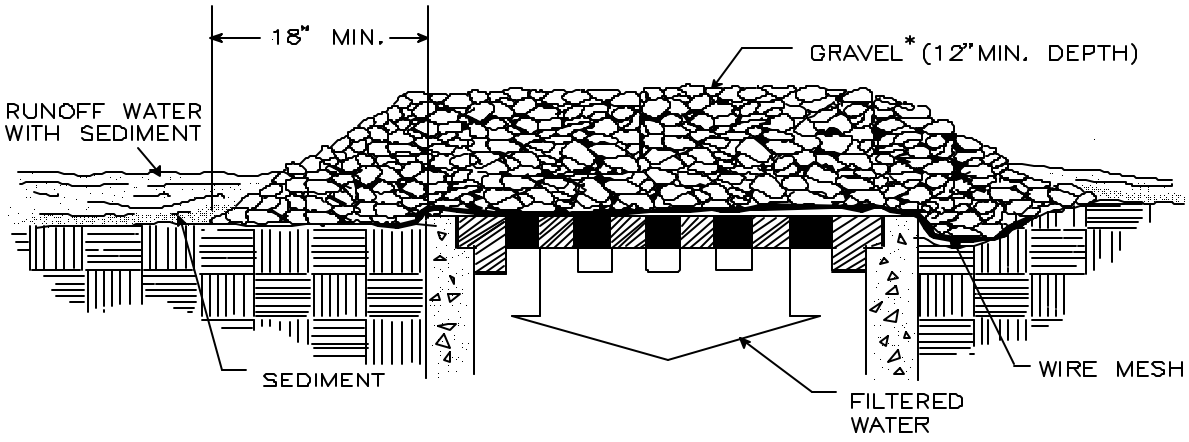
SPECIFIC APPLICATION

THIS METHOD OF INLET PROTECTION IS APPLICABLE WHERE THE INLET DRAINS A RELATIVELY FLAT AREA (SLOPE NO GREATER THAN 5%) WHERE THE INLET SHEET OR OVERLAND FLOWS (NOT EXCEEDING 1 C.F.S.) ARE TYPICAL. THE METHOD SHALL NOT APPLY TO INLETS RECEIVING CONCENTRATED FLOWS, SUCH AS IN STREET OR HIGHWAY MEDIANS.

SOURCE: N.C. Erosion and Sediment Control Planning and Design Manual, 1988 PLATE 3.07-1

STORM DRAIN INLET PROTECTION

GRAVEL AND WIRE MESH DROP INLET SEDIMENT FILTER



SPECIFIC APPLICATION

THIS METHOD OF INLET PROTECTION IS APPLICABLE WHERE HEAVY CONCENTRATED FLOWS ARE EXPECTED, BUT NOT WHERE PONDING AROUND THE STRUCTURE MIGHT CAUSE EXCESSIVE INCONVENIENCE OR DAMAGE TO ADJACENT STRUCTURES AND UNPROTECTED AREAS.

* GRAVEL SHALL BE VDOT #3, #357 OR #5 COARSE AGGREGATE.

SOURCE: VA. DSWC PLATE. 3.07–2

STORM DRAIN INLET PROTECTION

4. Excavated Drop Inlet Sediment Trap

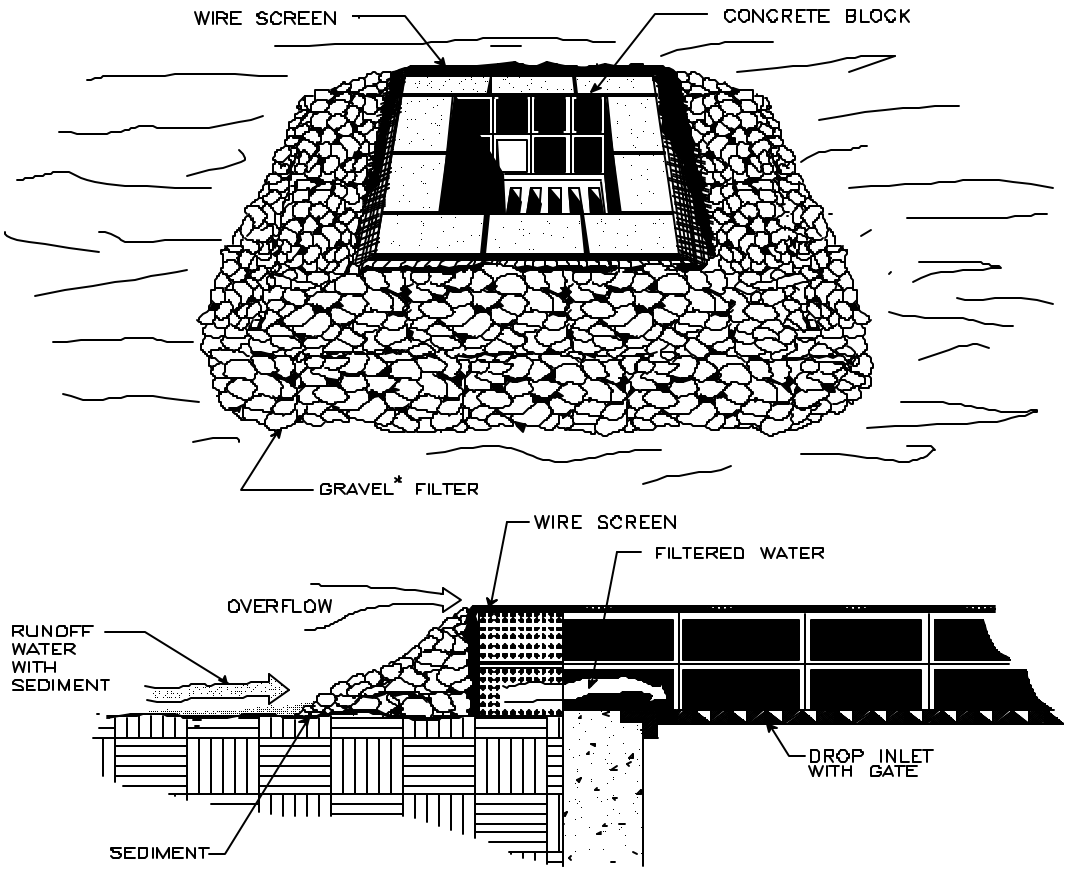
   a. The excavated trap shall be sized to provide a minimum storage capacity calculated at the rate of 134 cubic yards per acre of drainage area. A trap shall be no less than 1-foot nor more than 2-feet deep measured from the top of the inlet structure. Side slopes shall not be steeper than 2:1 (see Plate 3.07-4).

   b. The slope of the basin may vary to fit the drainage area and terrain. Observations must be made to check trap efficiency and modifications shall be made as necessary to ensure satisfactory trapping of sediment. Where an inlet is located so as to receive concentrated flows, such as in a highway median, it is recommended that the basin have a rectangular shape in a 2:1 (length/width) ratio, with the length oriented in the direction of the flow.

   c. Sediment shall be removed and the trap restored to its original dimensions when the sediment has accumulated to one-half the design depth of the trap. Removed sediment shall be deposited in a suitable area and in a manner such that it will not erode.

STORM DRAIN INLET PROTECTION

BLOCK AND GRAVEL DROP INLET SEDIMENT FILTER



SPECIFIC APPLICATION

THIS METHOD OF INLET PROTECTION IS APPLICABLE WHERE HEAVY FLOWS ARE EXPECTED AND WHERE AN OVERFLOW CAPACITY IS NECESSARY TO PREVENT EXCESSIVE PONDING AROUND THE STRUCTURE.

* GRAVEL SHALL BE VDOT #3, #357 OR #5 COARSE AGGREGATE.

SOURCE: VA. DSWC PLATE. 3.07–3

STORM DRAIN INLET PROTECTION

5. Sod Drop Inlet Sediment Filter

   a. Soil shall be prepared and sod installed according to the specifications in Std. & Spec. 3.33, SODDING.

   b. Sod shall be placed to form a turf mat covering the soil for a distance of 4 feet from each side of the inlet structure, as depicted in Plate 3.07-5.

6. Gravel Curb Inlet Sediment Filter

   a. Wire mesh with 1/2-inch openings shall be placed over the curb inlet opening so that at least 12 inches of wire extends across the inlet cover and at least 12 inches of wire extends across the concrete gutter from the inlet opening, as depicted in Plate 3.07-6.

   b. Stone shall be piled against the wire so as to anchor it against the gutter and inlet cover and to cover the inlet opening completely.

   c. If the stone filter becomes clogged with sediment so that it no longer adequately performs its function, the stone must be pulled away from the block, cleaned and replaced.

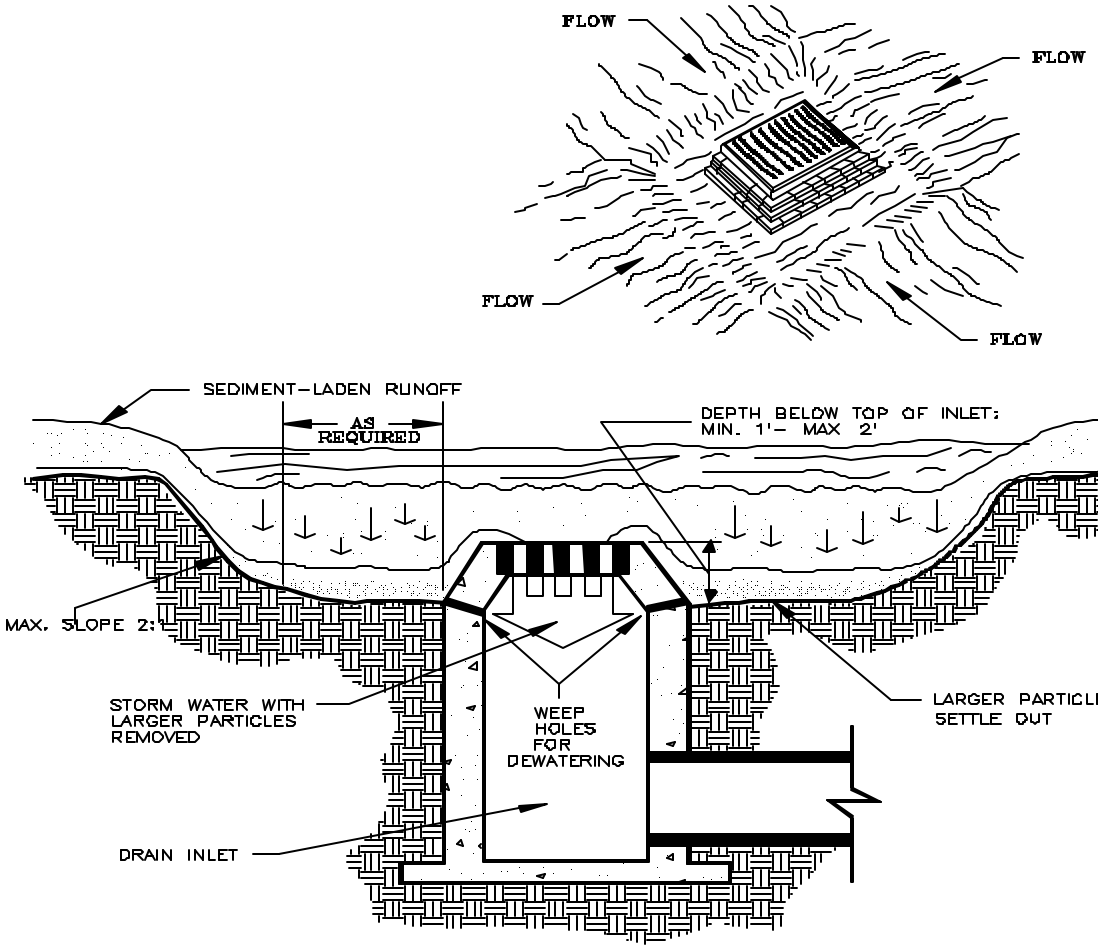
7. Curb Inlet Protection with 2"x 4"Wooden Weir

   a. Attach a continuous piece of wire mesh (30-inch minimum width x inlet throat length plus 4 feet) to the 2-inch x 4-inch wooden weir (with a total length of throat length plus 2 feet) as shown in Plate 3.07-7. Wood should be "construction grade" lumber.

   b. Place a piece of approved "extra-strength" filter cloth of the same dimensions as the wire mesh over the wire mesh and securely attach to the 2-inch x 4-inch weir.

STORM DRAIN INLET PROTECTION

EXCAVATED DROP INLET SEDIMENT TRAP



SPECIFIC APPLICATION

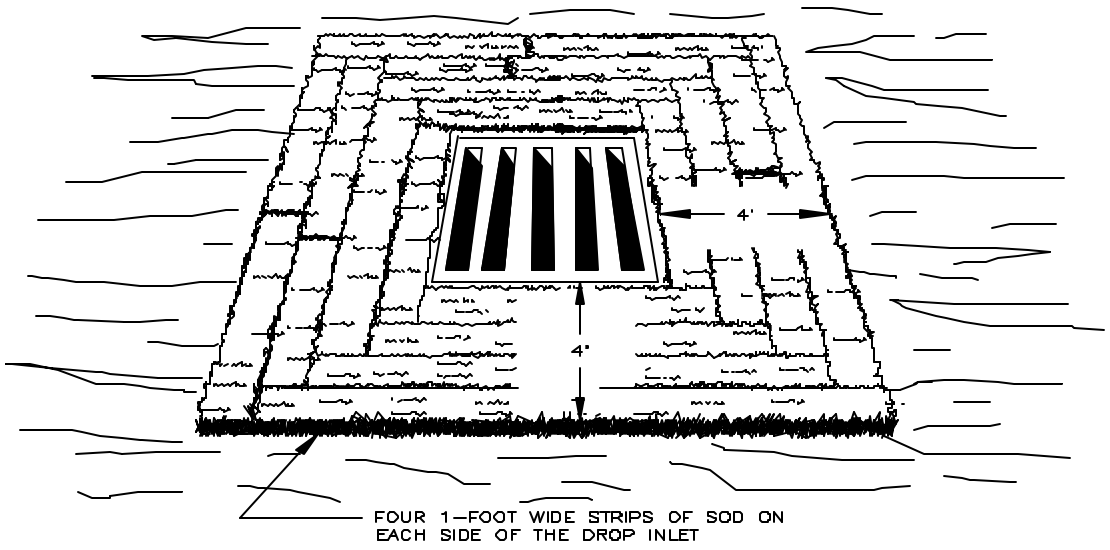
THIS METHOD OF INLET PROTECTION IS APPLICABLE WHERE HEAVY FLOWS ARE EXPECTED AND WHERE AN OVERFLOW CAPABILITY AND EASE OF MAINTENANCE ARE DESIRABLE.

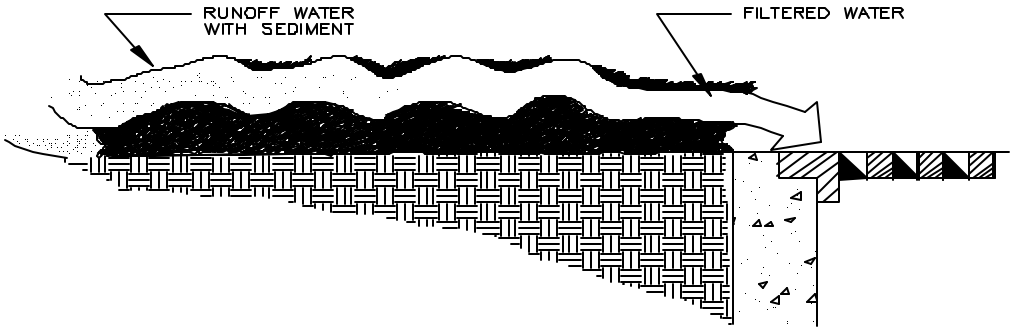
SOURCE: MICHIGAN SOIL EROSION AND SEDIMENT CONTROL GUIDEBOOK, 1975, AND USDA-SCS

PLATE 3.07-4

STORM DRAIN INLET PROTECTION

SOD DROP INLET SEDIMENT FILTER





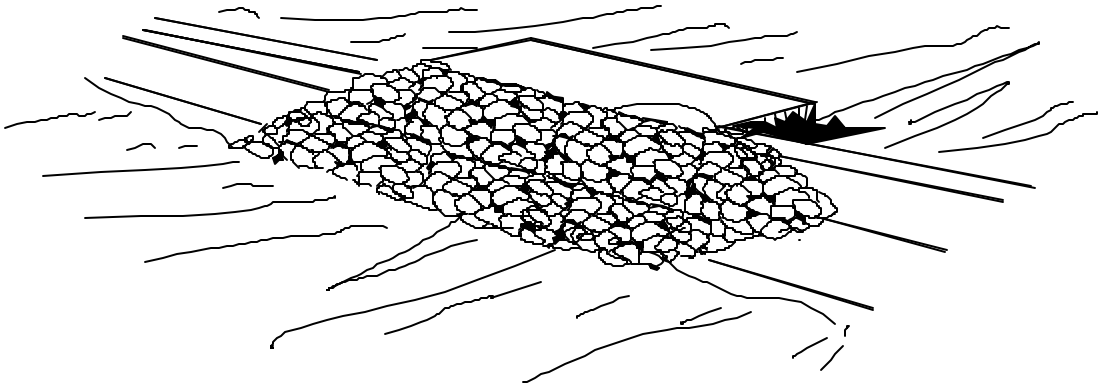
SPECIFIC APLLICATION

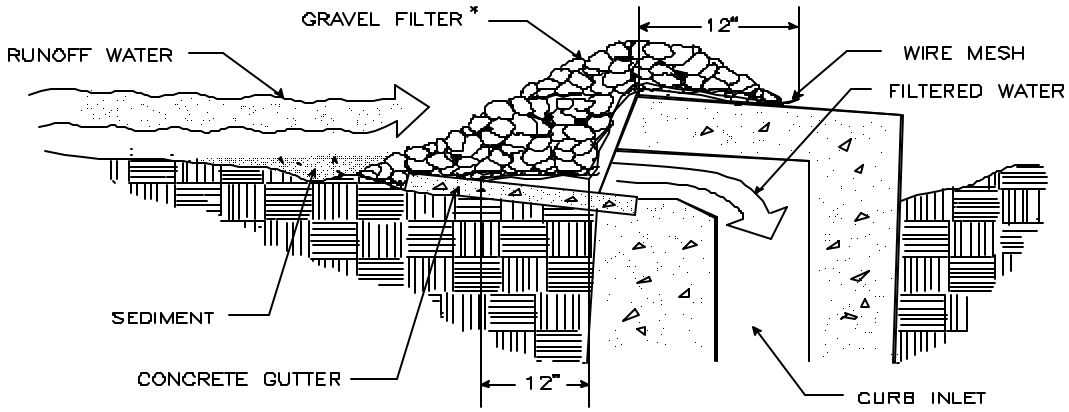
THIS METHOD OF INLET PROTECTION IS APPPLICABLE ONLY AT THE TIME OF PERMANENT SEEDING, TO PROTECT THE INLET FROM SEDIMENT AND MULCH MATERIAL UNTIL PERMANENT VEGETATION HAS BECOME ESTABLISHED.

SOURCE: VA. DSWC **PLATE 3.07—5**

STORM DRAIN INLET PROTECTION

GRAVEL CURB INLET SEDIMENT FILTER





SPECIFIC APPLICATION

THIS METHOD OF INLET PROTECTION IS APPLICABLE AT CURB INLETS WHERE PONDING IN FRONT OF THE STRUCTURE IS NOT LIKELY TO CAUSE INCONVENIENCE OR DAMAGE TO ADJACENT STRUCTURES AND UNPROTECTED AREAS.

* GRAVEL SHALL BE VDOT #3, #357 OR 5 COARSE AGGREGATE.

SOURCE: VA. DSWC PLATE 3.07–6

c. Securely nail the 2-inch x 4-inch weir to the 9-inch long vertical spacers which are to be located between the weir and inlet face at a maximum 6-foot spacing.

d. Place the assembly against the inlet throat and nail 2-foot (minimum) lengths of 2-inch x 4-inch board to the top of the weir at spacer locations. These 2-inch x 4-inch anchors shall extend across the inlet tops and be held in place by sandbags or alternate weight.

e. The assembly shall be placed so that the end spacers are a minimum 1 foot beyond both ends of the throat opening.

f. Form the wire mesh and filter cloth to the concrete gutter and against the face of curb on both sides of the inlet. Place coarse aggregate over the wire mesh and filter fabric in such a manner as to prevent water from entering the inlet under or around the filter cloth.

g. This type of protection must be inspected frequently and the filter cloth and stone replaced when clogged with sediment.

h. Assure that storm flow does not bypass inlet by installing temporary earth or asphalt dikes directing flow into inlet.

8. Block and Gravel Curb Inlet Sediment Filter

a. Two concrete blocks shall be placed on their sides abutting the curb at either side of the inlet opening.

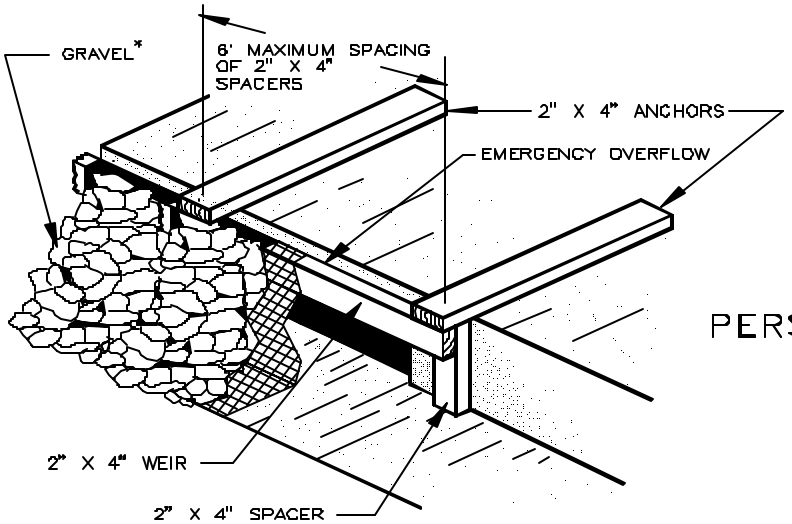
b. A 2-inch x 4-inch stud shall be cut and placed through the outer holes of each spacer block to help keep the front blocks in place.

c. Concrete blocks shall be placed on their sides across the front of the inlet and abutting the spacer blocks as depicted in Plate 3.07-8.

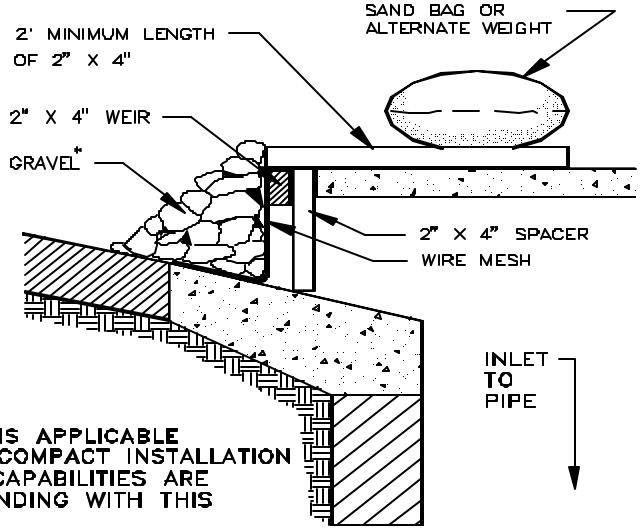
d. Wire mesh shall be placed over the outside vertical face (webbing) of the concrete blocks to prevent stone from being washed through the holes in the blocks. Wire mesh with 1/2-inch openings shall be used.

STORM DRAIN INLET PROTECTION

CURB INLET PROTECTION WITH 2-INCH X 4-INCH WOODEN WEIR



PERSPECTIVE VIEW



SIDE ELEVATION

SPECIFIC APPLICATION

THIS METHOD OF INLET PROTECTION IS APPLICABLE TO CURB INLETS WHERE A STURDY, COMPACT INSTALLATION IS DESIRED. EMERGENCY OVERFLOW CAPABILITIES ARE MINIMAL, SO EXPECT SIGNIFICANT PONDING WITH THIS MEASURE.

*GRAVEL SHALL BE VDOT COARSE AGGREGATE #3, #357 OR #5

SOURCE: USDA SCS

PLATE 3.07-7

e. Coarse aggregate shall be piled against the wire to the top of the barrier as shown in Plate 3.07-8.

f. If the stone filter becomes clogged with sediment so that it no longer adequately performs its function, the stone must be pulled away from the blocks, cleaned and/or replaced.

Maintenance

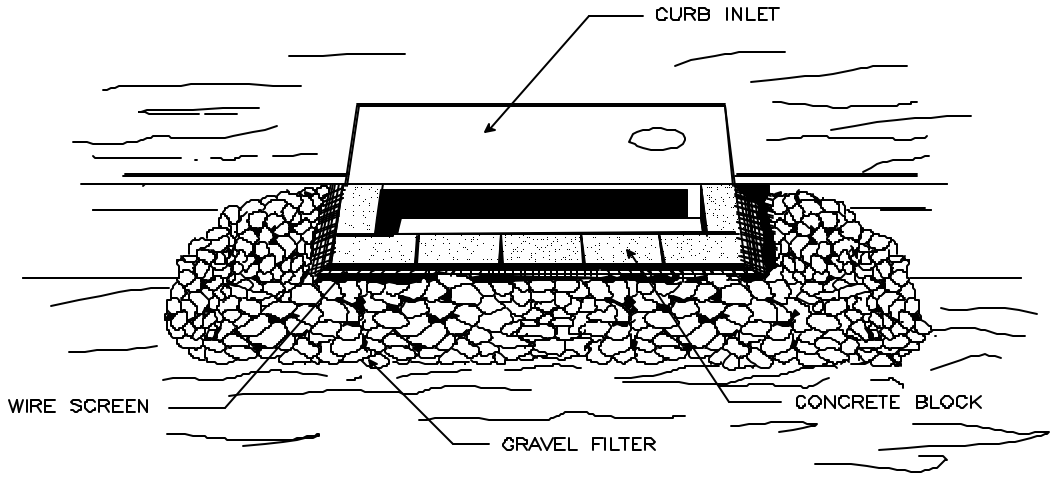
1. The structure shall be inspected after each rain and repairs made as needed.

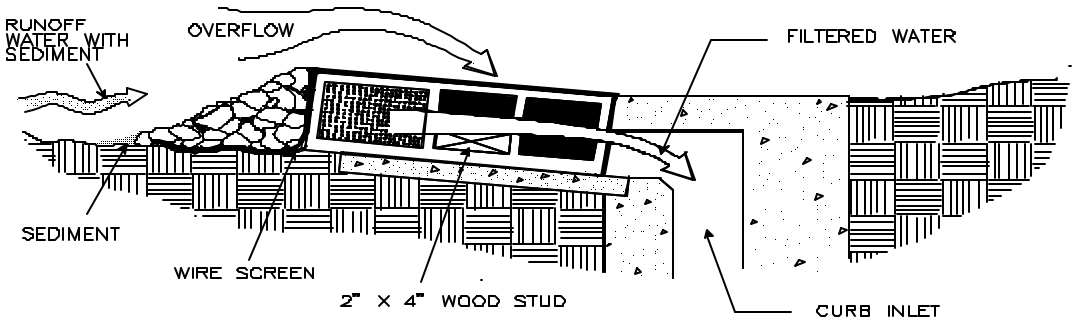
2. Sediment shall be removed and the trap restored to its original dimensions when the sediment has accumulated to one half the design depth of the trap. Removed sediment shall be deposited in a suitable area and in such a manner that it will not erode.

3. Structures shall be removed and the area stabilized when the remaining drainage area has been properly stabilized.

STORM DRAIN INLET PROTECTION

BLOCK & GRAVEL CURB INLET SEDIMENT FILTER





SPECIAL APPLICATION

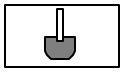
THIS METHOD OF INLET PROTECTION IS APPLICABLE AT CURB INLETS WHERE AN OVERFLOW CAPABILITY IS NECESSARY TO PREVENT EXCESSIVE PONDING IN FRONT OF THE STRUCTURE.

* GRAVEL SHALL BE VDOT #3, #357 OR #5 COARSE AGGREGATE

SOURCE: VA. DSWC PLATE 3.07-8

STORM DRAIN INLET PROTECTION

STD & SPEC 3.08
CULVERT INLET PROTECTION



CIP

Practice Description

A sediment filter located at the inlet to storm sewer culverts, used to prevent sediment from entering, accumulating in and being transferred by a culvert and associated drainage system prior to permanent stabilization of a disturbed project area; and, to provide erosion control at culvert inlets during the phase of a project where elevation and drainage patterns change, causing original control measures to be ineffective or in need of removal.

Conditions Where Practice Applies

Where culvert and associated drainage system is to be made operational prior to permanent stabilization of the disturbed drainage area. Different types of structures are applicable to different conditions (see Plates 3.08-1 and 3.08-2).

General Guidelines (All Types)

1. The inlet protection device shall be constructed in a manner that will facilitate clean-out and disposal of trapped sediment and minimize interference with construction activities.

2. The inlet protection devices shall be constructed in such a manner that any resultant ponding of stormwater will not cause excessive inconvenience or damage to adjacent areas or structures.

3. Design criteria more specific to each particular inlet protection device will be found in Plates 3.08-1 through 3.08-2.

Construction Specifications

1. Silt Fence Culvert Inlet Protection

   a. The height of the silt fence (in front of the culvert opening) shall be a minimum of 16 inches and shall not exceed 34 inches.

b. Extra strength filter fabric with a maximum spacing of stakes of 3 feet shall be used to construct the measure.

c. The placement of silt fence should be approximately 6 feet from the culvert in the direction of incoming flow, creating a "horseshoe" shape as shown in Plate 3.08-1.

d. If silt fence cannot be installed properly or the flow and/or velocity of flow to the culvert protection is excessive and may breach the structure, the stone combination noted in Plate 3.08-1 should be utilized.

2. Culvert Inlet Sediment Trap

a. Geometry of the design will be a "horseshoe" shape around the culvert inlet (see Plate 3.08-2).

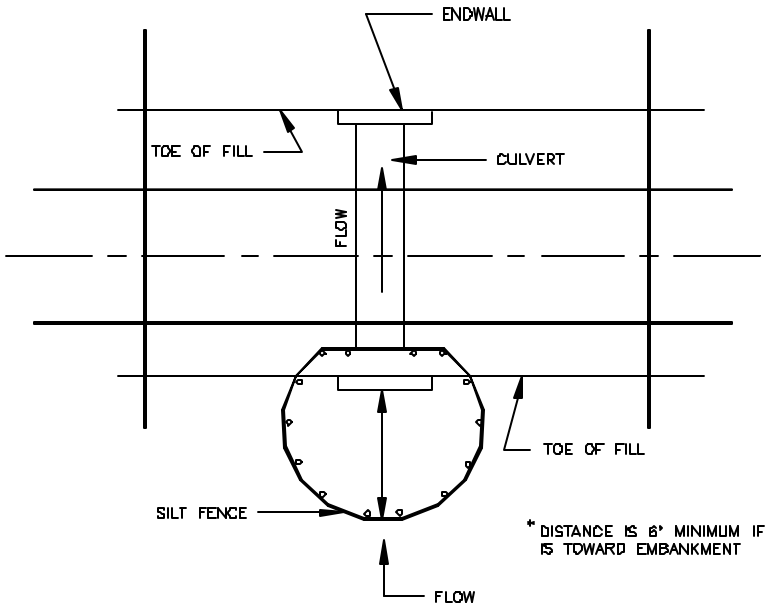
b. The toe of riprap (composing the sediment filter dam) shall be no closer than 24" from the culvert opening in order to provide an acceptable emergency outlet for flows from larger storm events.

c. All other "Construction Specifications" found within Std. & Spec. 3.13, TEMPORARY SEDIMENT TRAP, also apply to this practice.

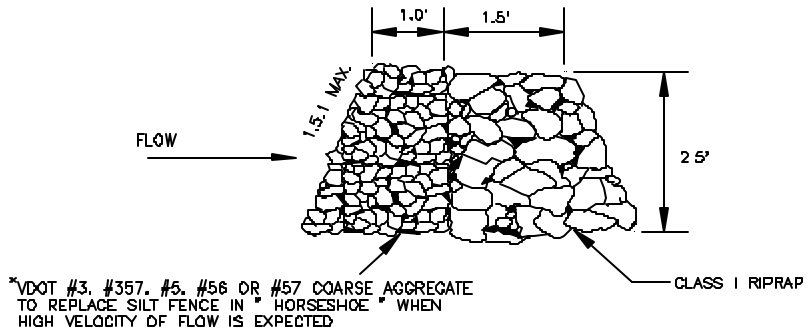
d. The proper installation of the culvert inlet sediment trap is a viable substitute for the installation of the TEMPORARY SEDIMENT TRAP.

CULVERT INLET PROTECTION

SILT FENCE CULVERT INLET PROTECTION



*OPTIONAL STONE COMBINATION

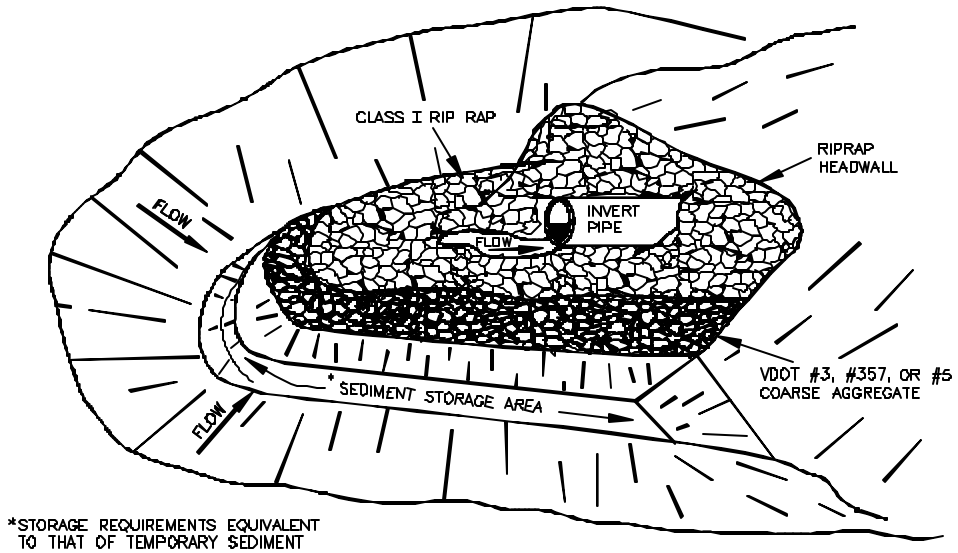


SOURCE: ADAPTED from VDOT Standard Sheets and Va. DSWC

PLATE. 3.08-1

CULVERT INLET PROTECTION

CULVERT INLET SEDIMENT TRAP

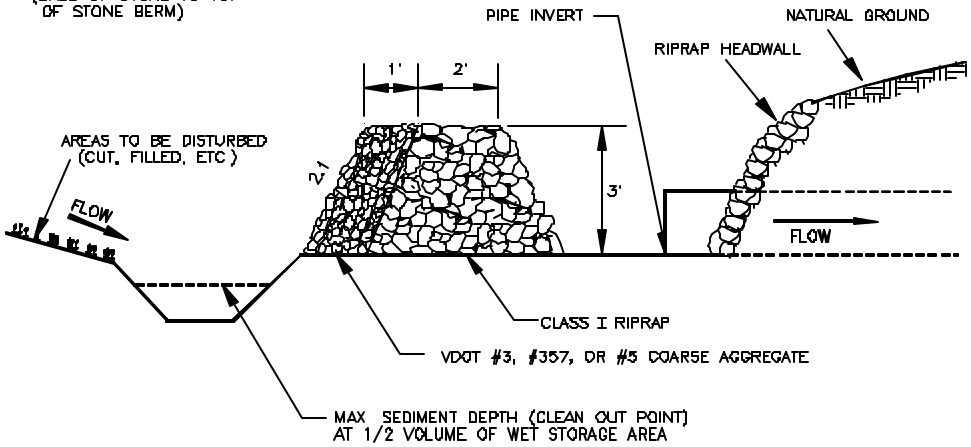


*STORAGE REQUIREMENTS EQUIVALENT TO THAT OF TEMPORARY SEDIMENT TRAP, STD. & SPEC. 3.13

67 C.Y./ACRE WET STORAGE (BELOW BASE OF STONE)

67 C.Y./ACRE DRY STORAGE (BASE OF STONE TO TOP OF STONE BERM)

PERSPECTIVE VIEW



ELEVATION

SOURCE: NORTH CAROLINA SEDIMENT CONTROL COMMISSION PLATE. 3.08–2

CULVERT INLET PROTECTION

Maintenance

1. The structure shall be inspected after each rain and repairs made as needed.

2. Aggregate shall be replaced or cleaned when inspection reveals that clogged voids are causing ponding problems that interfere with on-site construction.

3. Sediment shall be removed and the impoundment restored to its original dimensions when sediment has accumulated to one-half the design depth. Removed sediment shall be deposited in a suitable area and in such a manner that it will not erode and cause sedimentation problems.

4. Temporary structures shall be removed when they have served their useful purpose, but not before the upslope area has been permanently stabilized.

CULVERT INLET PROTECTION

STD & SPEC 3.09
TEMPORARY DIVERSION DIKE

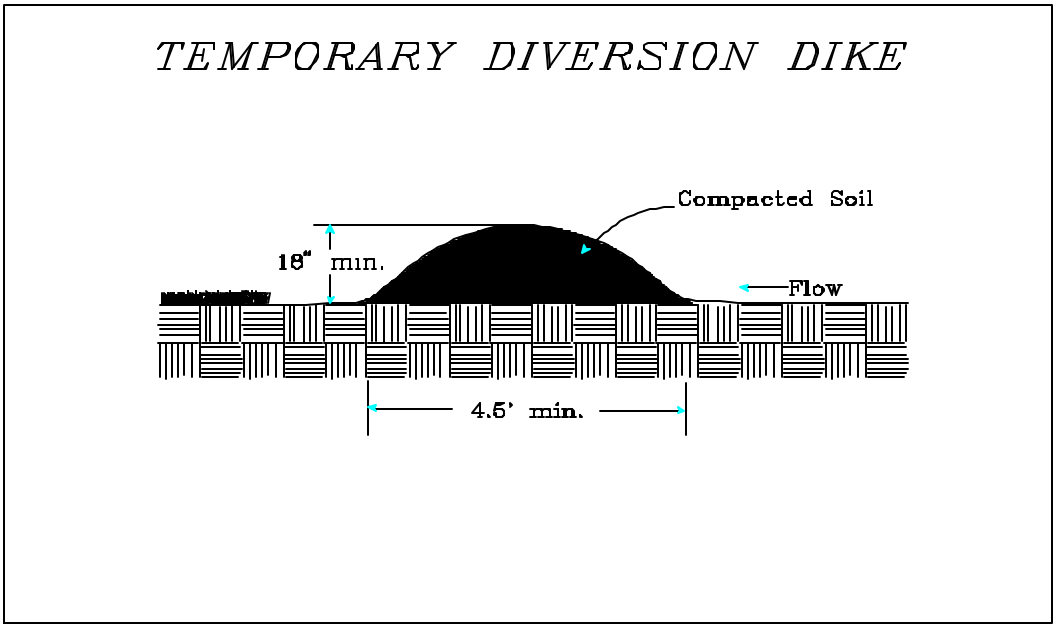
DD DD

Practice Description

A temporary ridge of compacted soil constructed at the top of a sloping disturbed area, to divert storm runoff from upslope drainage areas away from unprotected disturbed areas and slopes to a stabilized outlet and to divert sediment-laden runoff from a disturbed area to sediment-trapping facility such as a sediment trap or sediment basin.

Conditions Where Practice Applies

Whenever stormwater runoff must be temporarily diverted to protect disturbed areas and slopes or retain sediment on site during construction. These structures generally have a life expectancy of 18 months or less, which can be prolonged with proper maintenance.



SOURCE. VA. DSWC PLATE 3.09—1

TEMPORARY DIVERSION DIKE

Construction Specifications

1. Height: The minimum allowable height measured from the upslope side of the dike is 18 inches.

2. Side Slopes: 1 1/2:1 or flatter, along with a minimum base width of 4.5 feet (see Plate 3.09-1).

3. Grade: The channel behind the dike shall have a positive grade to a stabilized outlet. If the channel slope is less than or equal to 2%, no stabilization is required. If the slope is greater 2%, the channel shall be stabilized in accordance with Std. & Spec. 3.17, STORMWATER CONVEYANCE CHANNEL.

4. Outlet: The diverted runoff, if free of sediment, must be released through a stabilized outlet or channel. Sediment-laden runoff must be diverted through a sediment trapping facility.

5. Temporary diversion dikes must be installed as a first step in the land-disturbing activity and must be functional prior to upslope land disturbance.

6. The dike should be adequately compacted to prevent failure.

7. Temporary or permanent seeding and mulch shall be applied to the dike immediately following its construction.

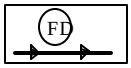
8. The dike should be located to minimize damages by construction and traffic.

Maintenance

The measure shall be inspected after every storm and repairs made to the dike, flow channel, outlet or sediment trapping facility, as necessary. Once every two weeks, whether a storm event has occurred or not, the measure shall be inspected and repairs made if needed. Damages caused by construction traffic or other activity must be repaired before the end of each working day.

TEMPORARY DIVERSION DIKE

STD & SPEC 3.10
TEMPORARY FILL DIVERSION



FD

Practice Description

A channel with a supporting ridge of soil on the lower side, constructed along the top of an active earth fill, to divert storm runoff away from the unprotected slope of the fill to a stabilized outlet or sediment-trapping facility.

Conditions Where Practice Applies

Where the drainage area at the top of an active earth fill slopes toward the exposed slope and where continuous fill operations make the use of a DIVERSION (Std. & Spec. 3.12) unfeasible. This temporary structure should remain in place for less than one week. The maximum allowable drainage area is 5 acres.

Construction Specifications

1. Height: The minimum height of the supporting ridge shall be 9 inches (see Plate 3.10-1).

2. Grade: The channel shall have a positive grade to a stabilized outlet.

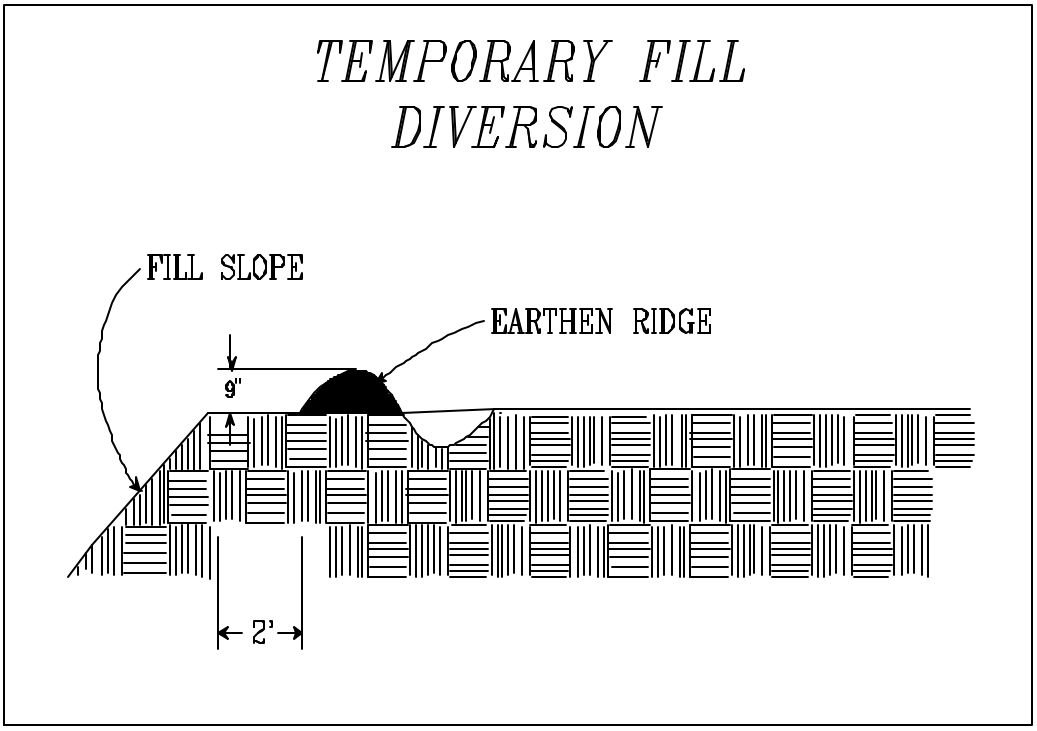
3. Outlet: The diverted runoff should be released through a stabilized outlet, slope drain or sediment trapping measure.

4. The diversion shall be constructed at the top of the fill at the end of each work day as needed.

5. The diversion shall be located at least 2 feet inside the top edge of the fill (see Plate 3.10-1).

6. The supporting ridge shall be constructed with a uniform height along its entire length. Without uniform height, the fill diversion may be susceptible to breaching.

TEMPORARY FILL DIVERSION



SOURCE: VA. DSWC PLATE 3.10-1

Maintenance

Since the practice is temporary and under most situations will be covered the next work day, the maintenance required should be low. If the practice is to remain in use for more than one day, an inspection will be made a the end of each work day and repairs made to the measure if needed. The contractor should avoid the placement of any material over the structure while it is in use. Construction traffic should not be permitted to cross the diversion.

TEMPORARY FILL DIVERSION

STD & SPEC 3.11
TEMPORARY RIGHT-OF-WAY DIVERSION

RWD

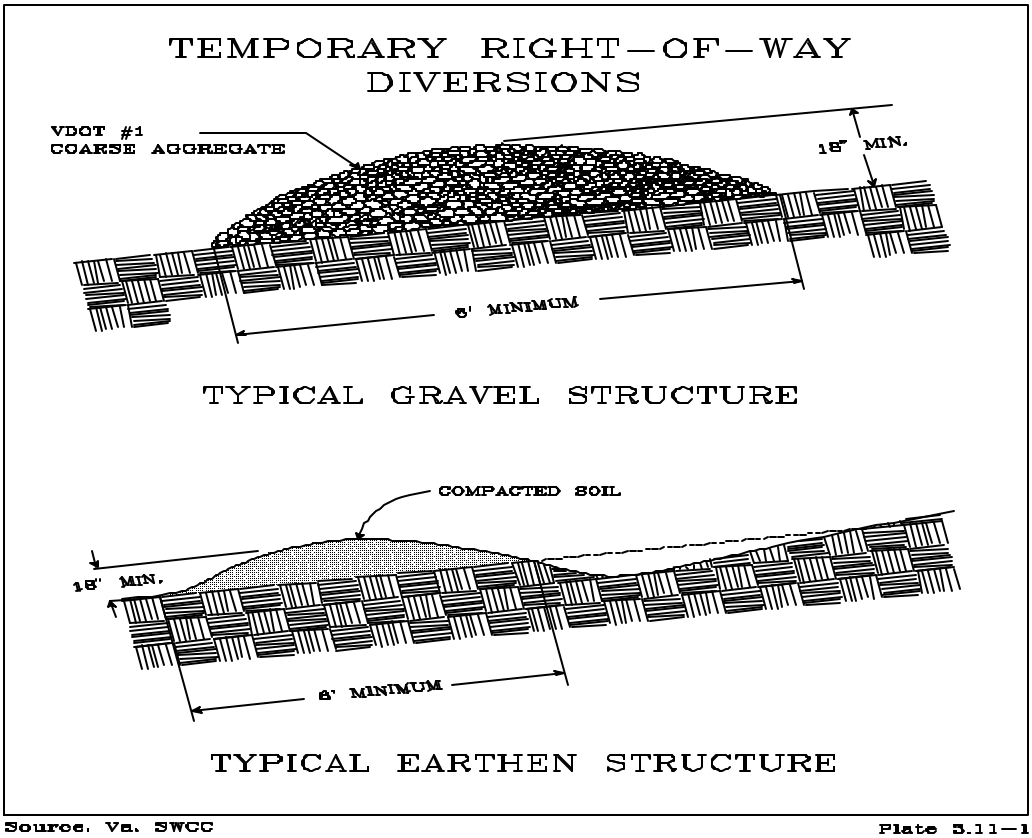
RWD

Practice Description

A ridge of compacted soil or loose rock or gravel constructed across disturbed rights-of-way and similar sloping areas, to shorten the flow length within a sloping right-of-way, thereby reducing the erosion potential by diverting storm runoff to a stabilized outlet.

Conditions Where Practice Applies

Generally, earthen diversions are applicable where there will be little or no construction traffic within the right-of-way. Gravel structures are more applicable to roads and other rights-of-way that accommodate vehicular traffic.



Source. Va. SWCC Plate 3.11—1

TEMP. RIGHT-OF-WAY DIVERSION

TABLE 3.11-A
SPACING OF RIGHT OF WAY
DIVERSIONS

%Slope	Spacing (ft.)
Less than 7%	100
Between 7% and 25%	75
Between 25% and 40%	50
Greater than 40%	25

Construction Specifications

1. Height: The minimum allowable height of the diversion shall be 18 inches (see Plate 3.11-1).

2. Side Slopes: Side slopes should be 2:1 or flatter to allow the passage of construction traffic, along with a minimum base width of 6 feet (see Plate 3.11-1).

3. Width: The measure should be constructed completely across the disturbed portion of the right-of-way.

4. Spacing: Table 3.11-A will be used to determine the spacing of right-of-way diversions.

5. Grade: Positive drainage (with less than 2% slope) should be provided to a stabilized outlet, sediment-trapping facility, or a vegetative buffer strip of adequate size.

6. The diversion shall be installed as soon as the right-of-way has been cleared and/or graded.

7. All earthen diversions shall be machine- or hand-compacted in 8-inch lifts.

8. The outlet of the diversion shall be located on an undisturbed and stabilized area when at all possible. The field location should be adjusted as needed to utilize a

TEMP. RIGHT-OF-WAY DIVERSION

stabilized outlet.

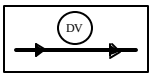
9. Earthen diversions which will not be subject to construction traffic should be stabilized in accordance with TEMPORARY SEEDING (Std. & Spec. 3.31).

Maintenance

The practice shall be inspected after every rainfall and repairs made if necessary. At least once every two weeks, whether a storm has occurred or not, the measure shall be inspected and repairs made if needed. Right-of-way diversions, which are subject to damage by vehicular traffic, should be reshaped at the end of each working day.

TEMP. RIGHT-OF-WAY DIVERSION

STD & SPEC 3.12
DIVERSION



DV

Practice Description

A channel constructed across a slope with a supporting earthen ridge on the lower side, to reduce slope length and to intercept and divert stormwater runoff to stabilized outlets at non-erosive velocities.

Conditions Where Practice Applies

1. Where runoff from areas of higher elevation may damage property, cause erosion, or interfere with the establishment of vegetation on lower areas.

2. Where surface and/or shallow subsurface flow is damaging sloping upland.

3. Where the slope length needs to be reduced to minimize soil loss.

Construction Specifications

1. Ridge: The supporting ridge cross-sectioned shall meet the following criteria:

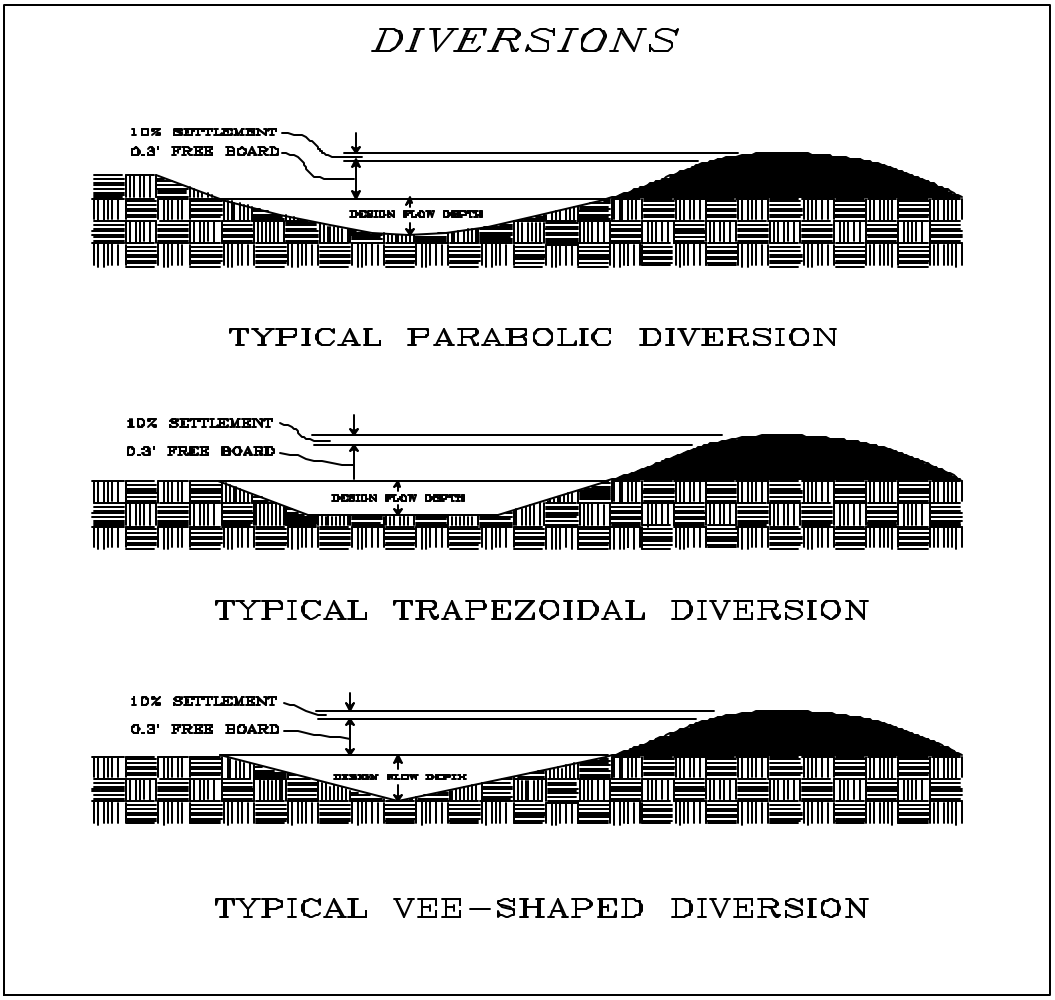
   a. The side slopes shall be no steeper than 2:1.

   b. The width at the design water elevation shall be a minimum of 4 feet.

   c. The minimum freeboard shall be 0.3 foot.

   d. The design shall include a 10 percent settlement factor.

2. Outlet: Diversions shall have adequate outlets which will convey concentrated runoff without erosion. Acceptable outlets include STORMWATER CONVEYANCE CHANNEL (Std. & Spec. 3.17); LEVEL SPREADER (Std. & Spec. 3.21); OUTLET PROTECTION (Std. & Spec. 3.18); and PAVED FLUME (Std. & Spec. 3.16).



Source: Va. DSWC Plate 3.12-1

3. Stabilization:

a. The ridge and channel shall be seeded and mulched immediately following their construction in accordance with Std. & Spec. 3.32, PERMANENT SEEDING.

b. Disturbed areas draining into the diversion should normally be seeded and mulched prior to the time the diversion is constructed. Sediment trapping measures must remain in place to prevent soil movement into the diversion if upslope area is not stabilized.

4. All trees, brush, stumps, obstructions, and other objectionable material shall be removed and disposed of so as not to interfere with the proper functioning of the diversion.

5. The diversion shall be excavated or shaped to line, grade, and cross-section as required to meet the criteria specified herein, free of irregularities that will impede flow.

6. Fills shall be compacted as needed to prevent unequal settlement that would cause damage in the completed diversion. Fill shall be composed of soil that is free from excessive organic debris, rocks or other objectionable materials.

7. All earth removed and not needed in construction shall be spread or disposed of so that it will not interfere with the functioning of the diversion.

8. Permanent stabilization of disturbed areas shall be done in accordance with the applicable standard and specification contained in this handbook. Permanent stabilization techniques include PERMANENT SEEDING (Std. & Spec. 3.32).

Maintenance

Before final stabilization, the diversion should be inspected after every rainfall and at least once every two weeks. Sediment shall be removed from the channel and repairs made as necessary. Seeded areas that fail to establish a vegetative cover shall be reseeded as necessary.

STD & SPEC 3.13
TEMPORARY SEDIMENT TRAP

ST

Practice Description

A temporary ponding area formed by constructing an earthen embankment with a stone outlet, used to detain sediment-laden runoff from small disturbed areas long enough to allow the majority of the sediment to settle out.

Conditions Where Practice Applies

1. Below disturbed areas where the total contributing drainage is less than 3 acres.

2. Where the sediment trap will be used no longer than 18 months (the maximum useful life is 18 months).

3. The sediment trap may be constructed either independently or in conjunction with a TEMPORARY DIVERSION DIKE (Std. & Spec. 3.09).

Construction Specifications

1. Outlet: The outlet for the sediment trap shall consist of a stone section of the embankment located at the low point in the basin. A combination of course aggregate and riprap shall be used to provide for filtering/detention as well as outlet stability. The smaller stone shall be VDOT #3, #357, or #5 Coarse Aggregate (smaller stone sizes will enhance filter efficiency) and riprap shall be "Class I". Filter cloth which meets the physical requirements noted in Std. & Spec. 3.19, RIPRAP shall be placed at the stone-soil interface to act as a "separator."

   The minimum length of the outlet shall be 6 feet times the number of acres comprising the total area draining to the trap. The crest of the stone outlet must be at least 1.0 foot below the top of the embankment to ensure that the flow will travel over the stone and not the embankment. The outlet shall be configured as noted in Plate 3.13-2.

2. Embankment Cross Section: The maximum height of the sediment trap embankment shall be 5 feet as measured from the base of the stone outlet. Minimum top widths (W) and outlet heights (Ho) for various embankment heights (H) are shown in Plate 3.13-1. Side slopes of the embankment shall be 2:1 of flatter.

3. The area under the embankment shall be cleared, grubbed, and stripped of any vegetation and root mat.

4. Fill material for the embankment shall be free of roots or other woody vegetation, organic material, large stones, and other objectionable material. The embankment should be compacted in 6-inch layers by traversing with construction equipment.

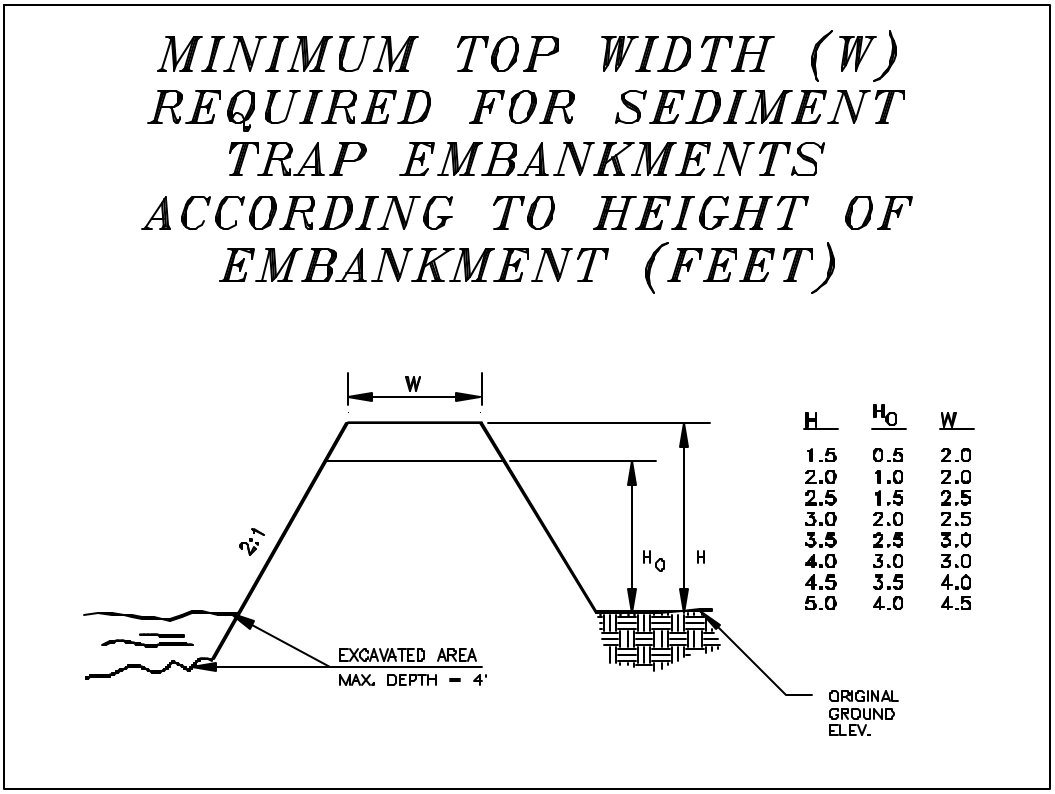
5. The earthen embankment shall be seeded with temporary or permanent vegetation (see Std. & Spec.'s 3.31 and 3.32) immediately after installation.

6. Construction operations shall be carried out in such a manner that erosion and water pollution are minimized.

7. The structure shall be removed and the area stabilized when the upslope drainage area has been stabilized.

8. All cut and fill slopes shall be 2:1 or flatter (except for excavated, wet storage area which may be at a maximum 1:1 grade).

TEMPORARY SEDIMENT TRAP



SOURCE: VA. DSWC PLATE. 3.13–1

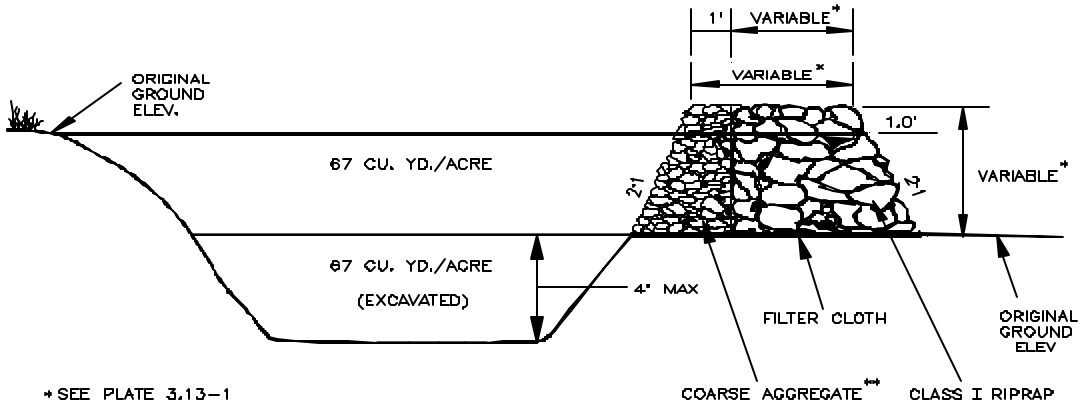
Maintenance

1. Sediment shall be removed and the trap restored to its original dimensions when the sediment has accumulated to one-half the design volume of the wet storage. Sediment removal from the basin shall be deposited in a suitable area and in such a manner that it will not erode and cause sedimentation problems.

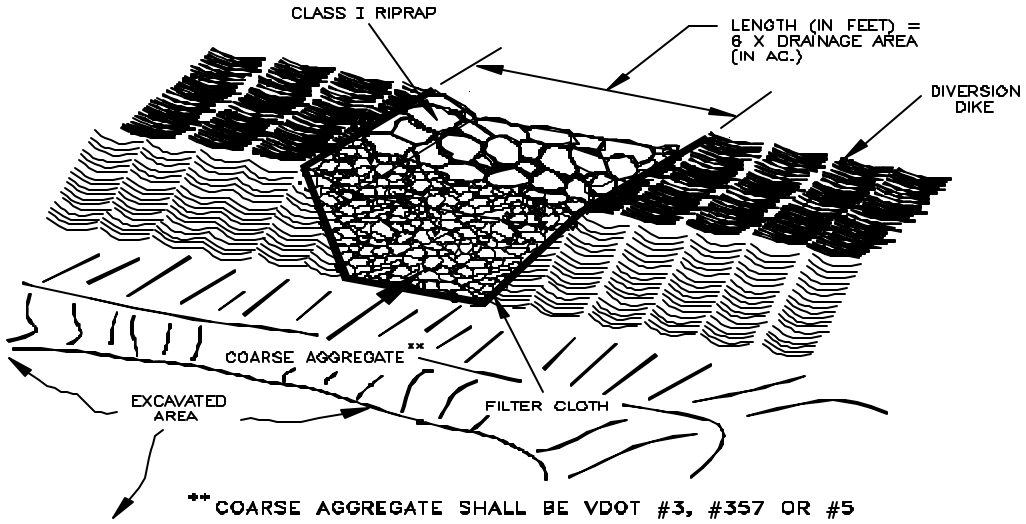
2. Filter stone shall be regularly checked to ensure that filtration performance is maintained. Stone choked with sediment shall be removed and cleaned or replaced.

3. The structure should be checked regularly to ensure that it is structurally sound and has not been damaged by erosion or construction equipment. The height of the stone outlet should be checked to ensure that its center is at least 1 foot below the top of the embankment.

TEMPORARY SEDIMENT TRAP



CROSS SECTION OF OUTLET



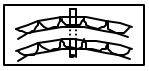
OUTLET (PERSPECTIVE VIEW)

SOURCE: VA. DSWC

PLATE. 3.13-2

TEMPORARY SEDIMENT TRAP

STD & SPEC 3.14
TEMPORARY SEDIMENT BASIN



SB

Practice Description

A temporary barrier or dam with a controlled stormwater release structure formed by constructing an embankment of compacted soil across a drainageway, used to detain sediment-laden runoff from disturbed areas in "wet" and "dry" storage long enough for the majority of the sediment to settle out.

Conditions Where Practice Applies

Constructed below disturbed areas where the total drainage area is equal to or greater than three (3) acres. There must be sufficient space and appropriate topography for the construction of a temporary impoundment. These structures are limited to a useful life of 18 months unless they are designed as permanent impoundments. It is recommended that these measures, by virtue of their potential to impound large volumes of water, be designed by a qualified professional.

Construction Specifications

1. Site Preparation: Areas under the embankment or any structural works related to the basin shall be cleared, grubbed, and stripped of topsoil to remove trees, vegetation, roots, and other objectionable material. In order to facilitate cleanout and restoration, the area of most frequent inundation (measured from the top of the principal spillway) will be cleared of all brush and trees.

2. Cutoff Trench: For earth-fill embankments, a cutoff trench shall be excavated along the centerline of the dam. The trench must extend at least 1 foot into a stable, impervious layer of soil and have a minimum depth of 2 feet. The cutoff trench shall extend up both abutments to the riser crest elevation. The minimum bottom width shall be 4 feet, but also must be wide enough to permit operation of compaction equipment. The side slopes shall be no steeper than 1:1.

   Compaction requirements shall be the same as those for the embankment. The trench shall be drained during the backfilling/compacting operations.

3. Embankment: For embankments of less than 10 feet, the embankment must have a minimum top width of 6 feet, and the side slopes must be 2:1 or flatter. In the case of an embankment 10 to 14 feet in height, the minimum top width shall be 8 feet and the side slopes shall be 2-1/2:1 or flatter. For 15-foot embankment (maximum allowed under these specifications), the top width must be 10 feet with maximum 2-1/2:1 side slopes.

   The fill material shall be taken from approved borrow areas. It shall be clean mineral soil, free of roots, woody vegetation, stumps, sod, oversized stones, rocks, or other perishable or objectionable material. The material selected must have enough strength for the dam to remain stable and be tight enough, when properly compacted, to prevent excessive percolation of water through the dam. Fill containing particles ranging from small gravel or coarse sand to fine sand and clay in desired proportion is appropriate. Any embankment material should contain approximately 20% clay particles by weight. Using the Unified Soil Classification System, SC (clayey sand), GC (clayey gravel) and CL ("low liquid limit" clay) are among the preferred types of embankment soils.

   Areas on which fill is to be placed shall be scarified prior to placement of fill. The fill material should contain the proper amount of moisture to ensure that 95% compaction will be achieved. Fill material will be placed in 6-inch continuous layers over the entire length of fill. Compaction shall be obtained by routing the hauling equipment over the fill so that the entire surface of the fill is transversed by at least one wheel or tread track of equipment, or by using a compactor. Special care shall be taken in compacting around the anti-seep collars (compact by hand, if necessary) to avoid damage and achieve the desired compaction. The embankment shall be constructed to an elevation 10% higher than the design height to allow for settlement if compaction is obtained with hauling equipment. If compactors are used for compaction, the overbuild may be reduced to not less than 5%.

4. Principal Spillway: To increase the efficiency of the basin, the spillway(s) must be designed to maintain a permanent pool of water between storm events. The principal spillway should consist of a solid (non-perforated) vertical box or pipe of reinforced concrete or corrugated metal, with a minimum diameter of 15 inches. The riser of the spillway shall be securely attached to the barrel by a watertight connection. The

TEMPORARY SEDIMENT BASIN

barrel and riser shall be placed on a firmly compacted soil foundation. The base of the riser shall be firmly anchored according to design criteria to prevent its floating. Pervious materials such as sand, gravel, or crushed stone shall not be used as backfill around the barrel or anti-seep collars. Special care shall be taken in compacting around the anti-seep collars (by hand, if necessary). Fill material shall be placed around the pipe in 4-inch layers and compacted until 95% compaction is achieved. A minimum of two feet of fill shall be hand-compacted over the barrel before crossing it with construction equipment.

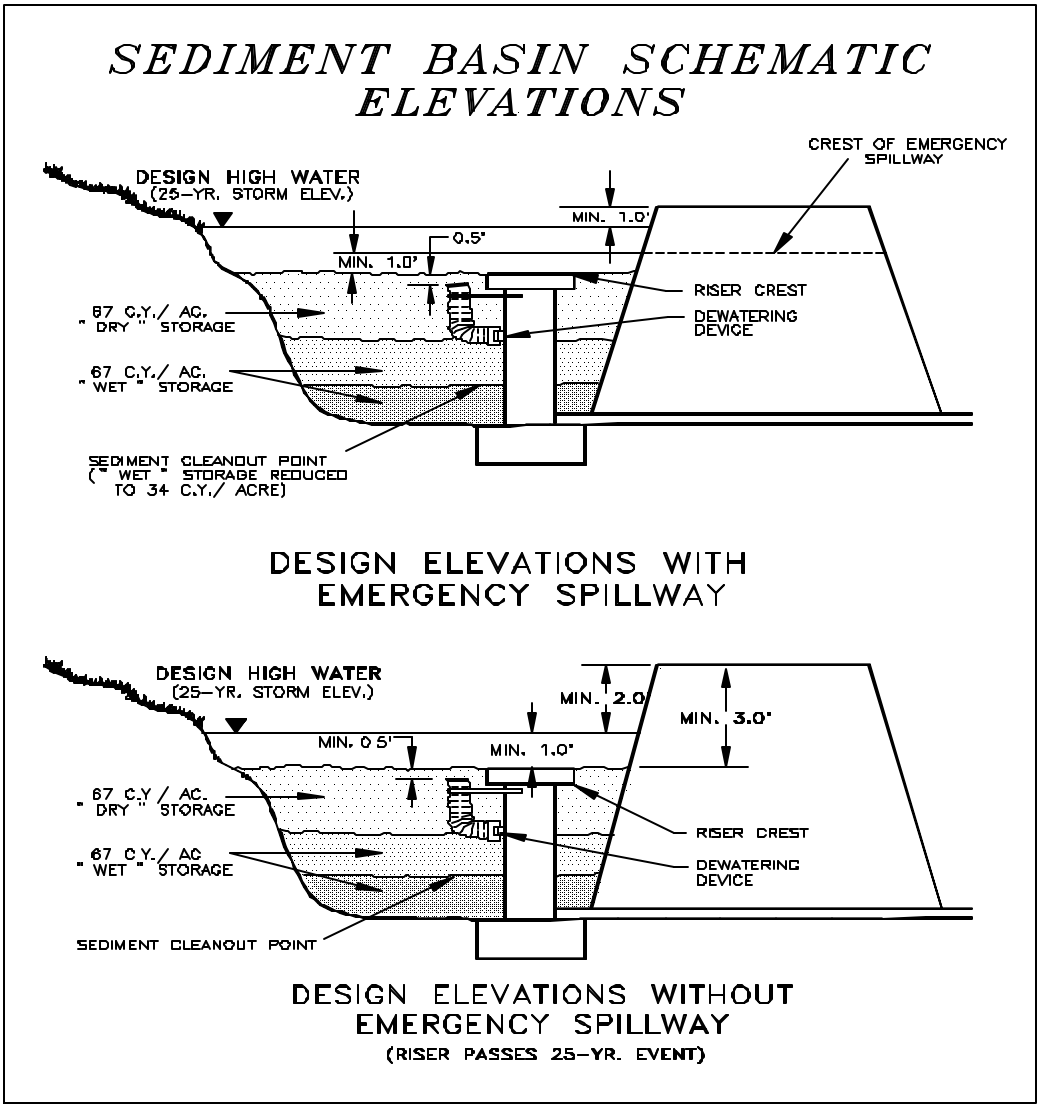
5. Base: The base of the principal spillway must be firmly anchored to prevent its floating. If the riser of the spillway is greater than 10 feet in height, computations must be made to determine the anchoring requirements. A minimum factor of safety of 1.25 shall be used (downward forces = 1.25 x upward forces).

   For risers 10 feet or less in height, the anchoring may be done in one of the two following ways:

   a. A concrete base 18 inches thick and twice the width of riser diameter shall be used and the riser embedded 6 inches into the concrete. (see Plate 3.14-14).

   b. A square steel plate a minimum of 1/4-inch thick and having a width equal to twice the diameter of the riser shall be used; it shall be covered with 2.5 feet of stone, gravel or compacted soil to prevent flotation (see Plate 3.14-14).

   Note: If the steel base is used, special attention should be given to compaction so that 95% compaction is achieved over the plate. Also, added precautions should be taken to ensure that material over the plate is not removed accidentally during removal of sediment from basin.



SOURCE: VA. DSWC

PLATE. 3.14-2

TEMPORARY SEDIMENT BASIN

6. Anti-Vortex Device and Trash Rack: An anti-vortex device and trash rack shall be attached to the top of the principal spillway to improve the flow characteristics of water into spillway and prevent floating debris from blocking the principal spillway. The anti-vortex device shall be of the concentric type as shown in Plate 3.14-10.

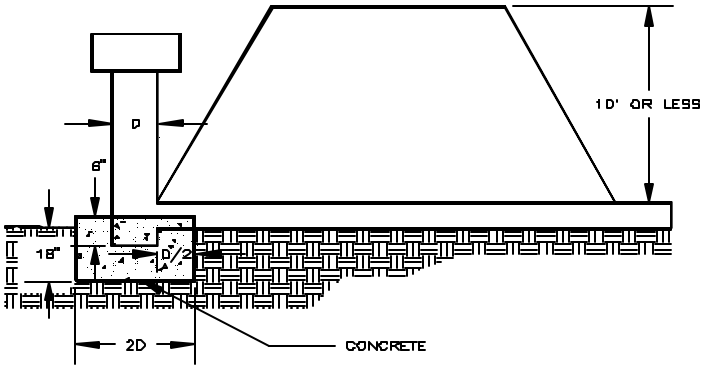
7. Dewatering: Dewatering of the dry storage should be done in a manner which removes the "cleaner" water without removing the potentially sediment-laden water found in the wet storage area or any appreciable quantities of floating debris.

   An economical and efficient device for performing the drawdown is a section of perforated vertical tubing that is connected to the principal spillway at two locations. See Plate 3.14-15 that depicts the orientation of such a device. By virtue of the potential for the dewatering device or orifice becoming clogged, no credit is given for drawdown by the device in the calculation of the principal or emergency spillway locations.

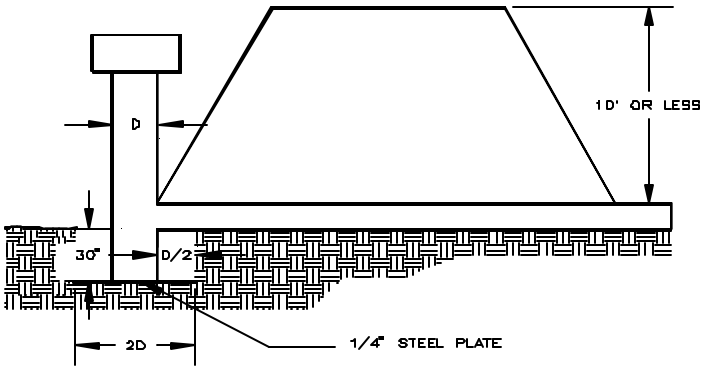
TEMPORARY SEDIMENT BASIN

RISER PIPE BASE CONDITIONS FOR EMBANKMENTS LESS THAN 10' HIGH

CONCRETE BASE FOR EMBANKMENT 10' OR LESS IN HEIGHT

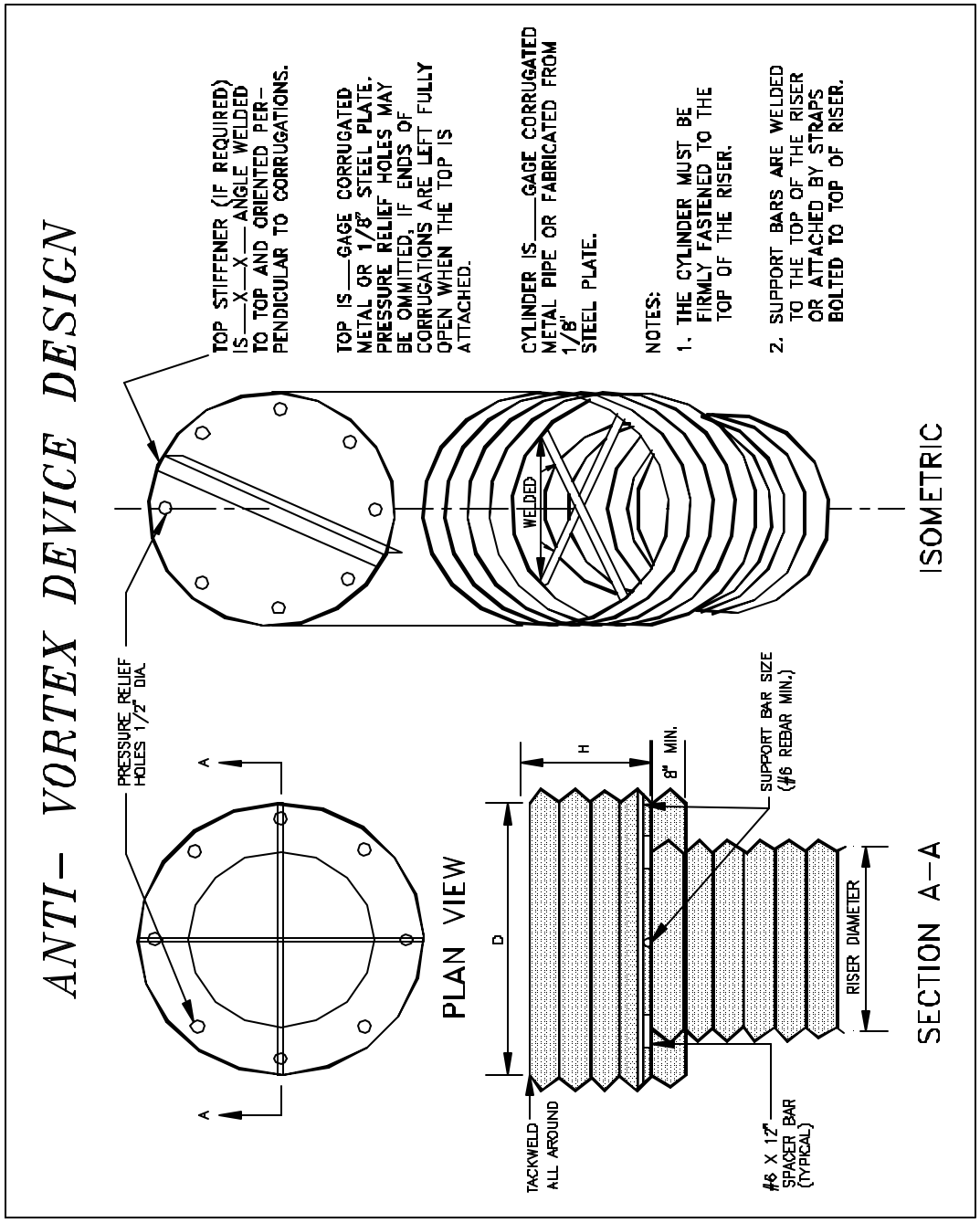


STEEL BASE FOR EMBANKMENT 10' OR LESS IN HEIGHT



SOURCE: VA. DSWC

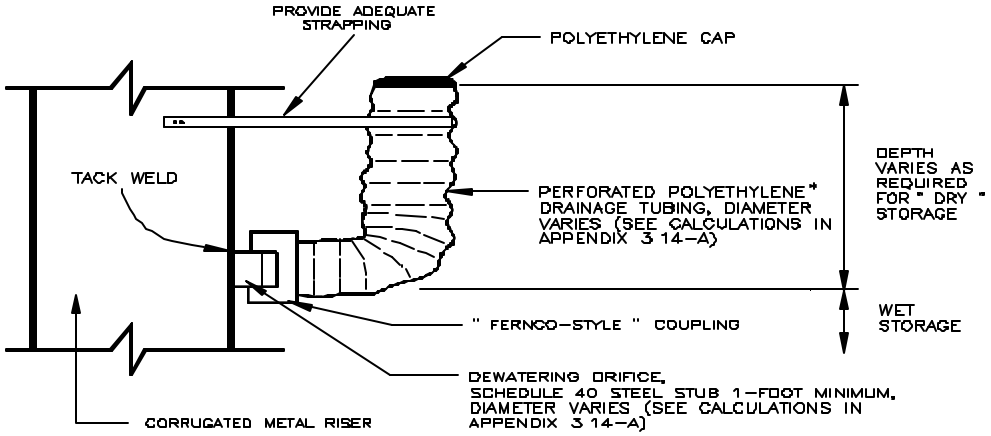
PLATE. 3.14-14



SOURCE: USDA-SCS PLATE. 3.14-10

TEMPORARY SEDIMENT BASIN

RECOMMENDED DEWATERING SYSTEM FOR SEDIMENT BASINS



NOTE: WITH CONCRETE RISER, USE PVC SCHEDULE 40 STUB FOR DEWATERING ORIFICE

*DRAINAGE TUBING SHALL COMPLY WITH ASTM F667 AND AASHTO M294

SOURCE: VA. DSWC

PLATE. 3.14-15

TEMPORARY SEDIMENT BASIN

8. Anti-Seep Collars: Anti-seep collars shall be used on the barrel of the principal spillway within the normal saturation zone of the embankment to increase the seepage length by at least 10%, if either of the following two conditions is met:

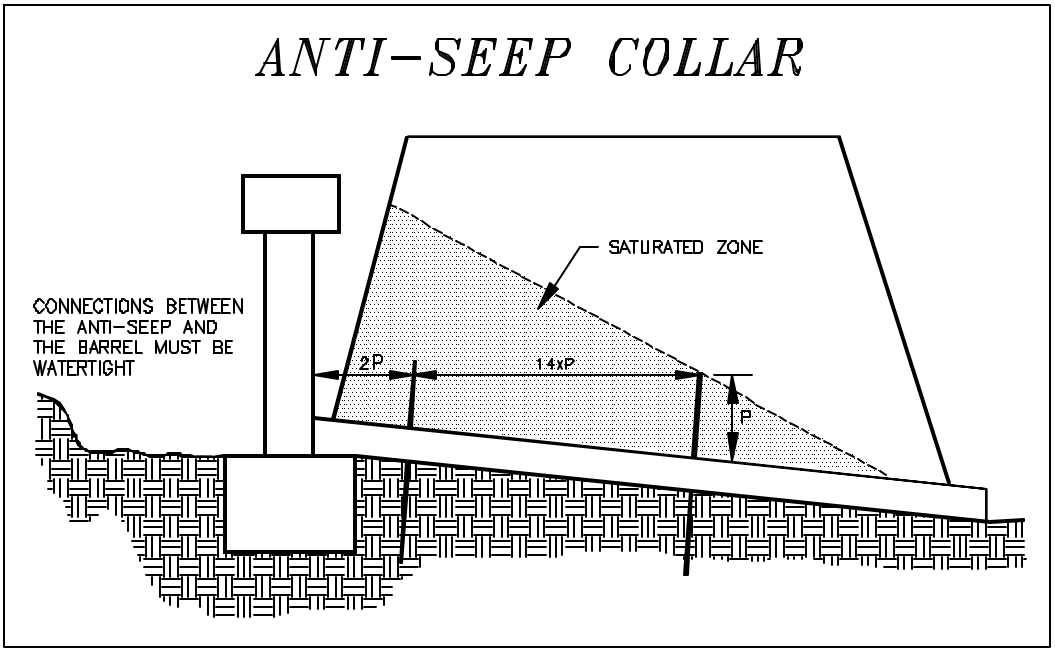
   a. The settled height of the embankment exceeds 10 feet.

   b. The embankment has a low silt-clay content (Unified Soil Classes SM or GM) and the barrel is greater than 10 inches in diameter.

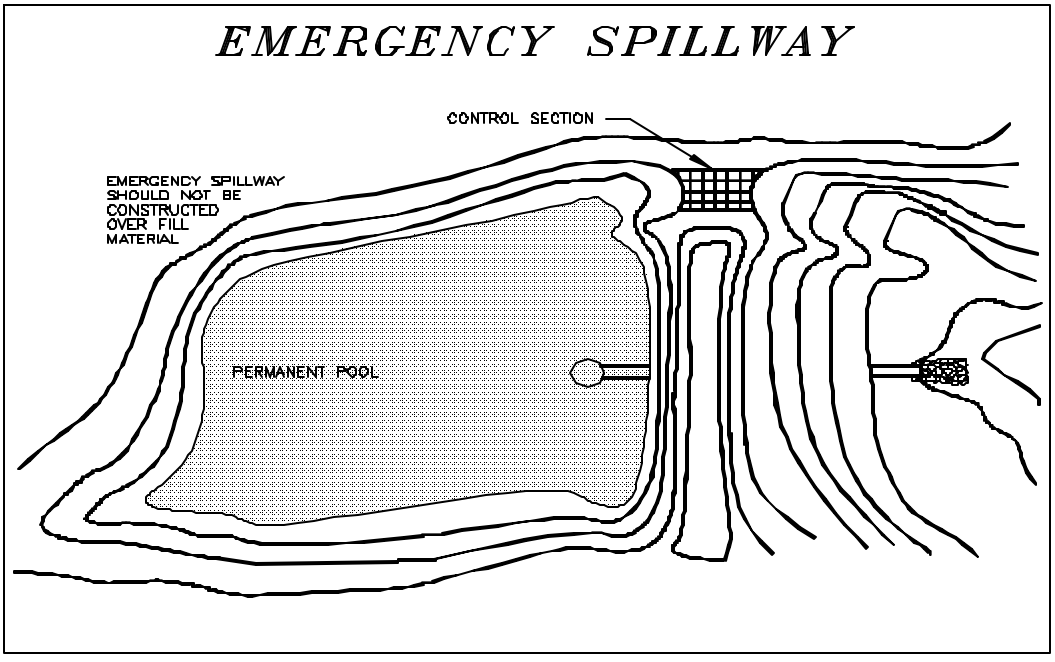
   The anti-seep collars shall be installed within the saturated zone. The maximum spacing between collars shall be 14 times the projection of the collars above the barrel. Collars shall not be closer than 2 feet to a pipe joint. Collars should be placed sufficiently far apart to allow space for hauling and compacting equipment. Precautions should be taken to ensure that 95% compaction is achieved around collars. Connections between the collars and the barrel shall be watertight (see Plate 3.14-5).

9. Alternatives to Anti-Seep Collars: Alternative measures to control seepage and piping have been developed and are being incorporated into embankment designs. These measures include a structure known as a "filter diaphragm." A filter diaphragm consists of a layer of sand and fine gravel which runs through the dam embankment perpendicular to the barrel. Typically, the structure is 4 to 5 inches in width, approximately one foot in height and is located at the barrel elevation at its intersection with the upper bounds of the seepage zone. The measure controls the transport of embankment fines, which is the major concern with piping and seepage. The diaphragm channels any undesirable flow through the fine-graded material, which traps any embankment material being transported. The flow is then conveyed out of the embankment through a perforated toe drain.

   The critical design element of the filter diaphragm is the grain-size distribution of the filter material which is determined by the grain-size distribution of the embankment fill material. The use and design of these measures should be based on site-specific geotechnical information and should be supervised by a qualified professional.



SOURCE: VA. DSWC PLATE. 3.14-4



SOURCE: VA. DSWC PLATE. 3.14-5

TEMPORARY SEDIMENT BASIN

10. Emergency Spillway: Vegetative emergency spillways shall not be constructed over fill material. Design elevations, widths, entrance and exit slopes are critical to the successful operation of the spillway and should be adhered to closely during construction.

11. Vegetative Stabilization: The embankment and emergency spillway of the sediment basin shall be stabilized with temporary or permanent vegetation immediately after installation of the basin (see TEMPORARY SEEDING, Std. & Spec. 3.31 or PERMANENT SEEDING, Std. & Spec. 3.32).

12. Basin Shape: The shape of the basin must be such that the length to width ratio is at least 2 to 1. The correct basin shape can be obtained by proper site selection, excavation, or the use of baffles. Baffles increase the flow length by deflecting the flow. The baffles should be placed halfway between the inflow point and the outflow. Plate 3.14-6 shows the detail for baffle construction and three situations where baffles might be used.

13. Safety: All state and local requirements shall be met concerning fencing and signs warning the public of the hazards of soft, saturated sediment and flood waters should be installed.

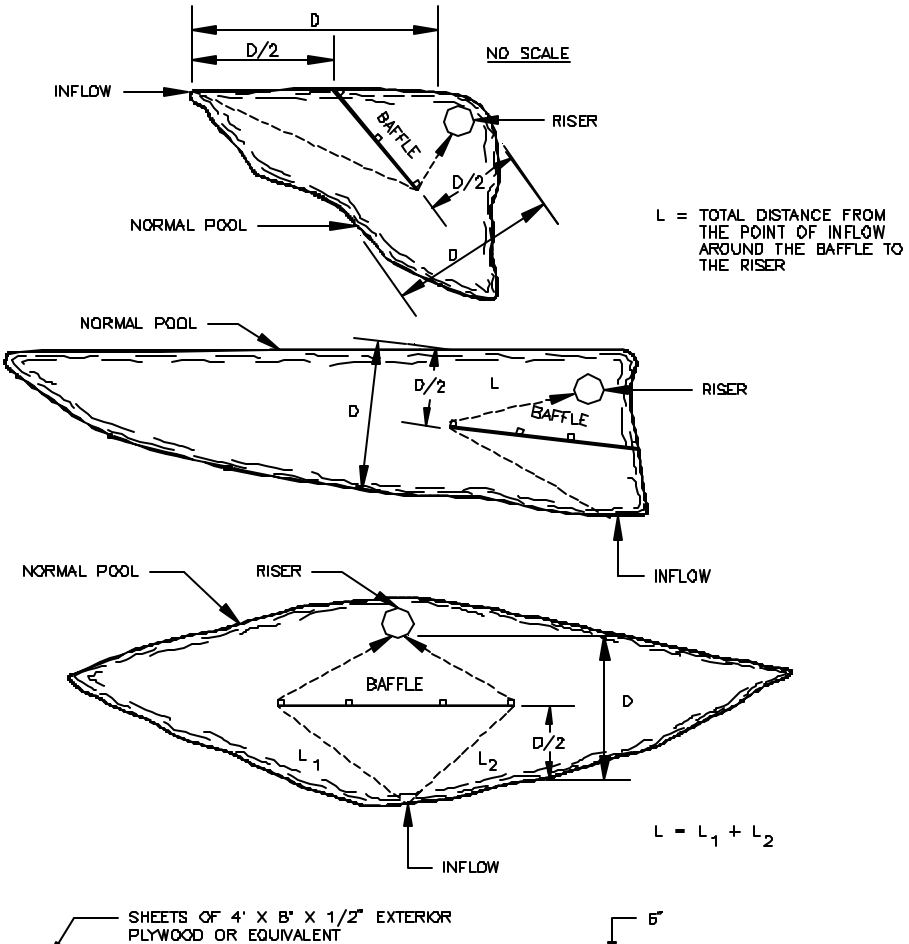
14. Erosion and Sediment Control: The construction of the sediment basin shall be carried out in a manner such that it does not result in sediment problems downstream.

Maintenance

The basin embankment should be checked regularly to ensure that it is structurally sound and has not been damaged by erosion or construction equipment. The emergency spillway should be checked regularly to ensure that its lining is well established and erosion resistant. The basin should be checked after each runoff-producing rainfall for sediment build-up. When sediment reaches the cleanout level, it shall be removed and properly disposed of.

TEMPORARY SEDIMENT BASIN

EXAMPLE PLAN VIEWS OF BAFFLE LOCATIONS IN SEDIMENT BASINS



SOURCE: USDA–SCS PLATE. 3.14–6

TEMPORARY SEDIMENT BASIN

STD & SPEC 3.15
TEMPORARY SLOPE DRAIN

TSD

Practice Description

A flexible tubing or conduit extending from the top to the bottom of a cut or fill slope, to temporarily conduct concentrated stormwater runoff safely down the face of a cut or fill slope without causing erosion on or below the slope.

Conditions Where Practice Applies

On cut or fill slopes where there is a potential for upslope flows to move over the face of the slope causing erosion and preventing adequate stabilization.

Construction Specifications

1. The measure shall be placed on undisturbed soil or well-compacted fill.

2. The entrance section shall slope toward the slope drain at the minimum rate of 1/2-inch per foot.

3. The soil around and under the entrance section shall be hand-tamped in 8-inch lifts to the top of the dike to prevent piping failure around the inlet.

4. The slope drain shall be securely staked to the slope at the grommets provided.

5. The slope drain sections shall be securely fastened together and have watertight fittings.

6. Install CULVERT INLET PROTECTION and OUTLET PROTECTION as per Std. & Spec.'s 3.08 and 3.18, respectively.

TEMPORARY SLOPE DRAIN

Table 3.15-A
SIZE OF SLOPE DRAIN

Maximum Drainage Area (acres)	Pipe Diameter (inches)
0.5	12
1.5	18
2.5	21
3.5	24
5.0	30

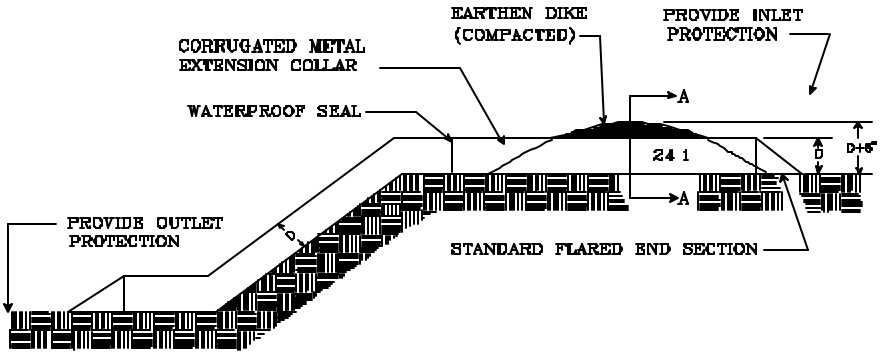
Source: Va. DSWC

Maintenance

The slope drain structure shall be inspected weekly and after every storm, and repairs made if necessary. The contractor should avoid the placement of any material on and prevent construction traffic across the slope drain.

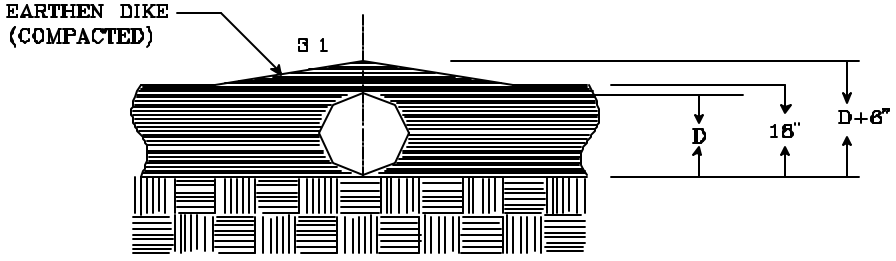
TEMPORARY SLOPE DRAIN

TEMPORARY SLOPE DRAIN



SECTION VIEW

NOTE: SEDIMENT MAY BE CONTROLLED AT OUTLET IF UPLAND PONDING WILL CREATE PROBLEMS

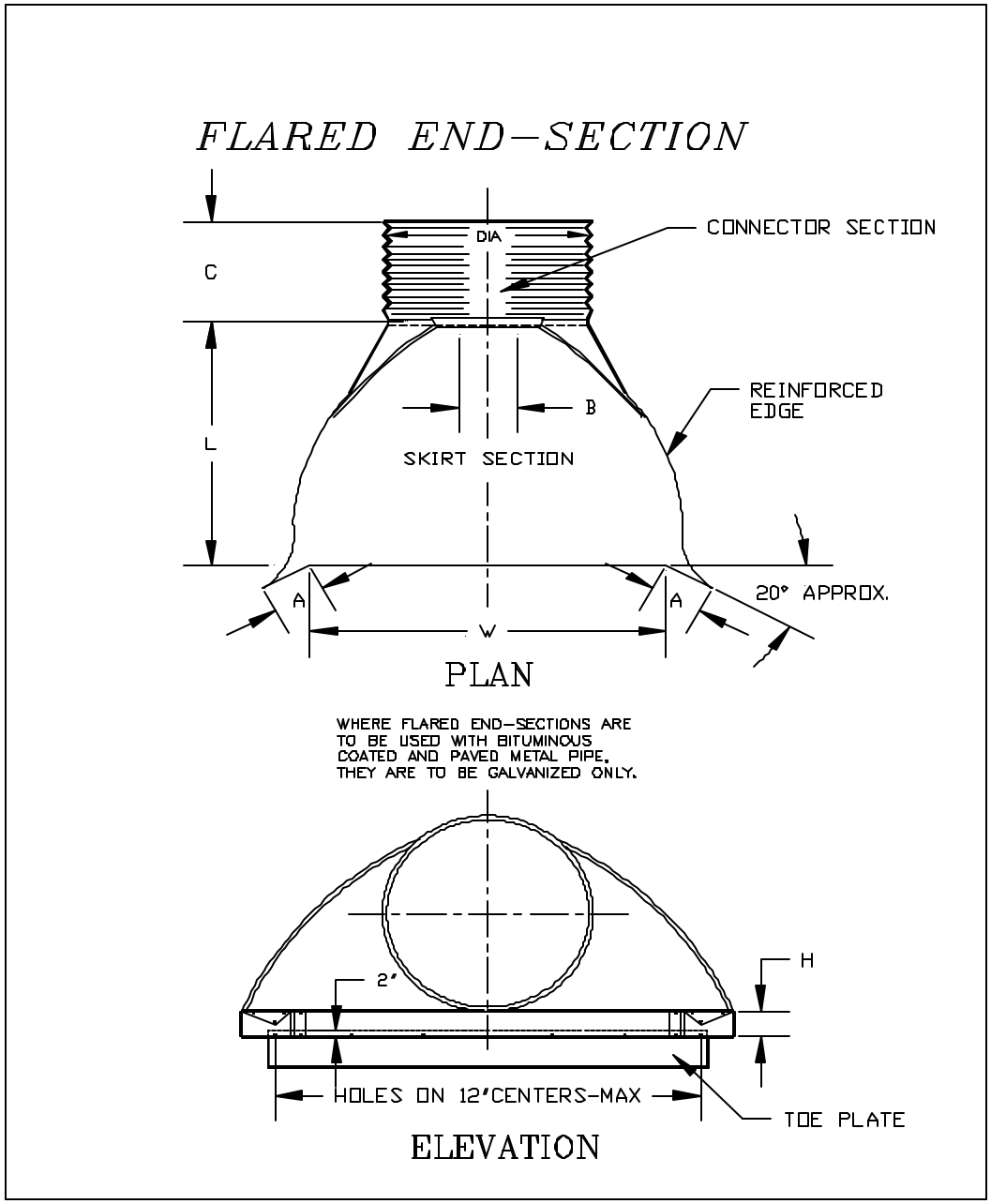


SECTION A – A

SOURCE: VA. DSWC

PLATE 3.15–1

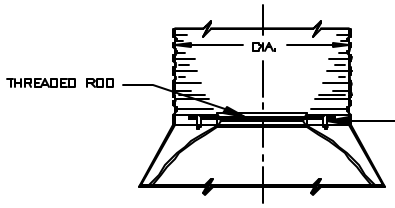
TEMPORARY SLOPE DRAIN



SOURCE: VDOT ROAD AND BRIDGE STANDARDS PLATE. 3.15-2

TEMPORARY SLOPE DRAIN

FLARED END-SECTION
(CONTINUED)



ALTERNATE CONNECTION

TOE PLATE, WHERE NEEDED, TO BE PUNCHED TO MATCH IN SKIRT LIP. 3/8" GALV. BOLTS TO BE FURNISHED. LENGTH OF TOE PLATE IS W + 10" FOR 12" TO 30" DIA PIPE AND W + 22" FOR 36" TO 60" DIA. PIPE.

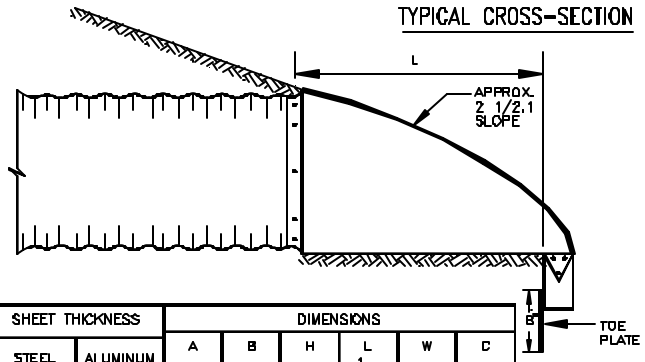
SKIRT SECTION FOR 12" TO 30" DIA PIPE TO BE MADE IN ONE PIECE.

SKIRT SECTION FOR 36" TO 54" DIA. PIPE MAY BE MADE FROM TWO SHEETS JOINED BY RIVETING OR BOLTING ON CENTER LINE. 60" MAY BE CONSTRUCTED IN 3 PIECES

CONNECTOR SECTION, CORNER PLATE AND TOE PLATE TO BE SAME SHEET THICKNESS AS SKIRT.

END-SECTIONS AND FITTINGS ARE TO BE GALVANIZED STEEL OR ALUMINUM ALLOY FOR USE WITH LIKE PIPE.

TYPICAL CROSS-SECTION



PIPE DIA.	SHEET THICKNESS		DIMENSIONS					
	STEEL	ALUMINUM	A ±1" TOL.	B MAX.	H ±1" TOL	L ±1 1/2" TOL.	W ±2" TOL.	C
12"	.064"	.080"	5"	6"	6"	21"	24"	24"
15"	.064"	.080"	7"	8"	6"	26"	30"	24"
18"	.064"	.080"	8"	10"	6"	31"	36"	24"
21"	.064"	.080"	10"	12"	6"	36"	42"	24"
24"	.064"	.080"	10"	13"	6"	41"	48"	24"
27"/30"	.064"	.075"	12"	16"	8"	51"	60"	24"
36"	.064"	.075"	14"	18"	8"	60"	72"	36"
42"	.064"	.105"	16"	22"	11"	69"	84"	36"
48"	.064"	.105"	18"	27"	12"	78"	90"	24"
54"	.064" / .079"	105"	18"	30"	12"	84"	102"	36"
60"	.064" / .109"	.105" / .135"	18"	33"	12"	87"	114"	36"

SOURCE: VDOT ROAD AND BRIDGE STANDARDS

PLATE 3.15-3

TEMPORARY SLOPE DRAIN

STD & SPEC 3.16
PAVED FLUME

PF

Practice Description

A permanent paved channel constructed on a slope, to conduct stormwater runoff safely down the face of a slope without causing erosion problems on or below the slope.

Conditions Where Practice Applies

Wherever concentrated stormwater runoff must be conveyed from the top to the bottom of cut or fill slopes on a permanent basis and a riprap-lined channel is not capable of conveying the runoff without erosion.

Construction Specifications

1. The subgrade shall be constructed to the required elevations. All soft sections and unsuitable material shall be removed and replaced with suitable material. The subgrade shall be thoroughly compacted and shaped to a smooth, uniform surface. The subgrade shall be moist at the time the concrete is poured.

2. The maximum slope of the structure shall be 1.5:1(67%).

3. Curtain Walls shall be provided at the beginning and end of all paved flumes not abutted to another structure. The curtain wall shall be as wide as the flume channel, extend at least 18 inches into the soil below the channel, and have a thickness of 6 inches. Curtain walls shall be reinforced with #4 reinforcing steel bars placed on 6-inch centers.

4. Anchor Lugs shall be spaced at a maximum of 10 feet on center for the length of the flume, and shall be found to be continuous with the channel lining.
   Where no curtain is required, an anchor lug shall be installed within 2 feet of the end of the flume. Anchor lugs are to be as wide as the bottom of the flume channel, extend at least 1 foot into the soil below the channel, and have a thickness of 6 inches. Anchor lugs shall be reinforced with #4 reinforcing steel bars placed on 4-inch centers.

5. The flume channel shall have at least a 4-inch thickness of class A-3 concrete with welded wire fabric (6 x 6 - W2.1 x W2.1) in the center for reinforcement.

6. Traverse joints for crack control should be provided at approximately 20-foot intervals and when more than 45 minutes elapses between consecutive concrete placements. All sections should be at least 6 feet long. Crack control joints may be formed by using a 1/8-inch thick removable template, by scoring or sawing to a depth of at least 3/4 inch or by an approved "leave-in" type insert.

7. Expansion joints shall be provided approximately every 90 feet. Eighteen-inch dowels of #4 reinforcing steel placed on 5-inch centers shall be located at all required joints.

8. Outlets of paved flumes should be protected from erosion. The use of an energy dissipator with OUTLET PROTECTION (Std. & Spec. 3.18) is recommended in order to temporarily reduce the existing velocity of the flow, thus preventing undermining of the structure and providing a stable transition zone between the flume and the receiving channel or drainage structure at the base of the slope. Plates 3.16-2 and 3.16-3 show a "Standard Energy Dissipator (EG-1)," which is designed for use in conjunction with the "Standard Paved Flume (PG-4)."

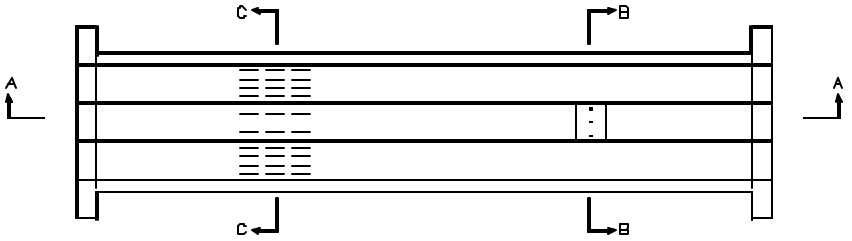
   OUTLET PROTECTION should not be utilized with the use of an "EG-1" structure to further dissipate flow energy and to provide a smooth transition into the receiving channel. Larger energy dissipator systems may be similarly designed for larger flume cross-sections.

Maintenance

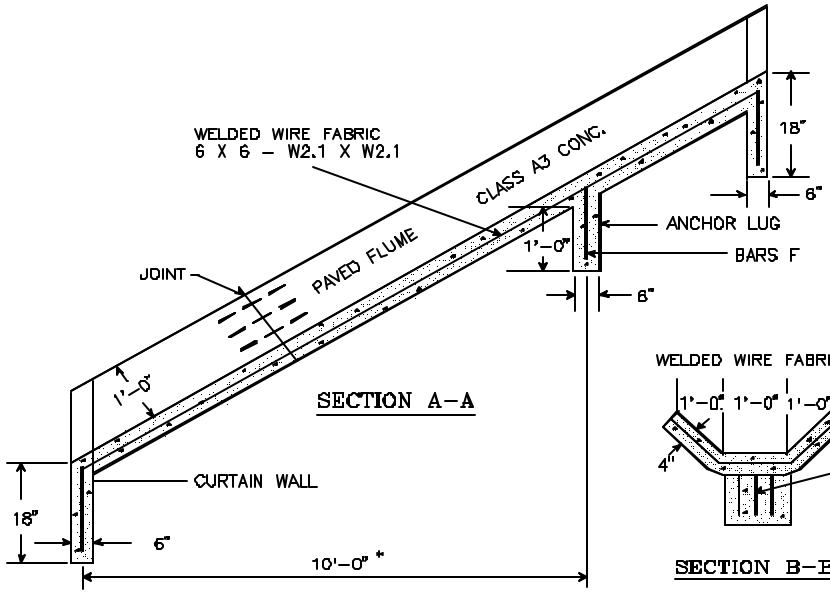
Prior to permanent stabilization of the slope, the structure should be inspected after each rainfall. Damages to the slope, flume or outlet area must be repaired immediately. After the slope is stabilized, the structure should be inspected to ensure continued adequate functioning (see potential problems noted in Planning Considerations).

PAVED FLUME

PAVED FLUME



PLAN VIEW



SECTION A–A

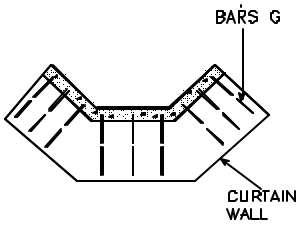
SECTION B–B

* 10'–0" C–C MAXIMUM TYPICAL SPACING BETWEEN ANCHOR LUGS. WHERE CURTAIN WALL IS NOT REQUIRED ANCHOR LUG IS TO BE A MAXIMUM OF 2' FROM END OF CHANNEL.

SCHEDULE OF REINFORCING STEEL

MARK	NO.	LENGTH		SIZE	SPACING C–C	SHAPE
		2:1	1 1/2:1			
F	3	1'–2"	1'–2"	4	4"	STRAIGHT
G	9	1'–5"	1'–5"	4	6"	STRAIGHT
DOWELS	10	1'–6"	1'–6"	4	5"	STRAIGHT

NO. SHOWN ARE FOR ONE ANCHOR LUG, CURTAIN WALL AND JOINT

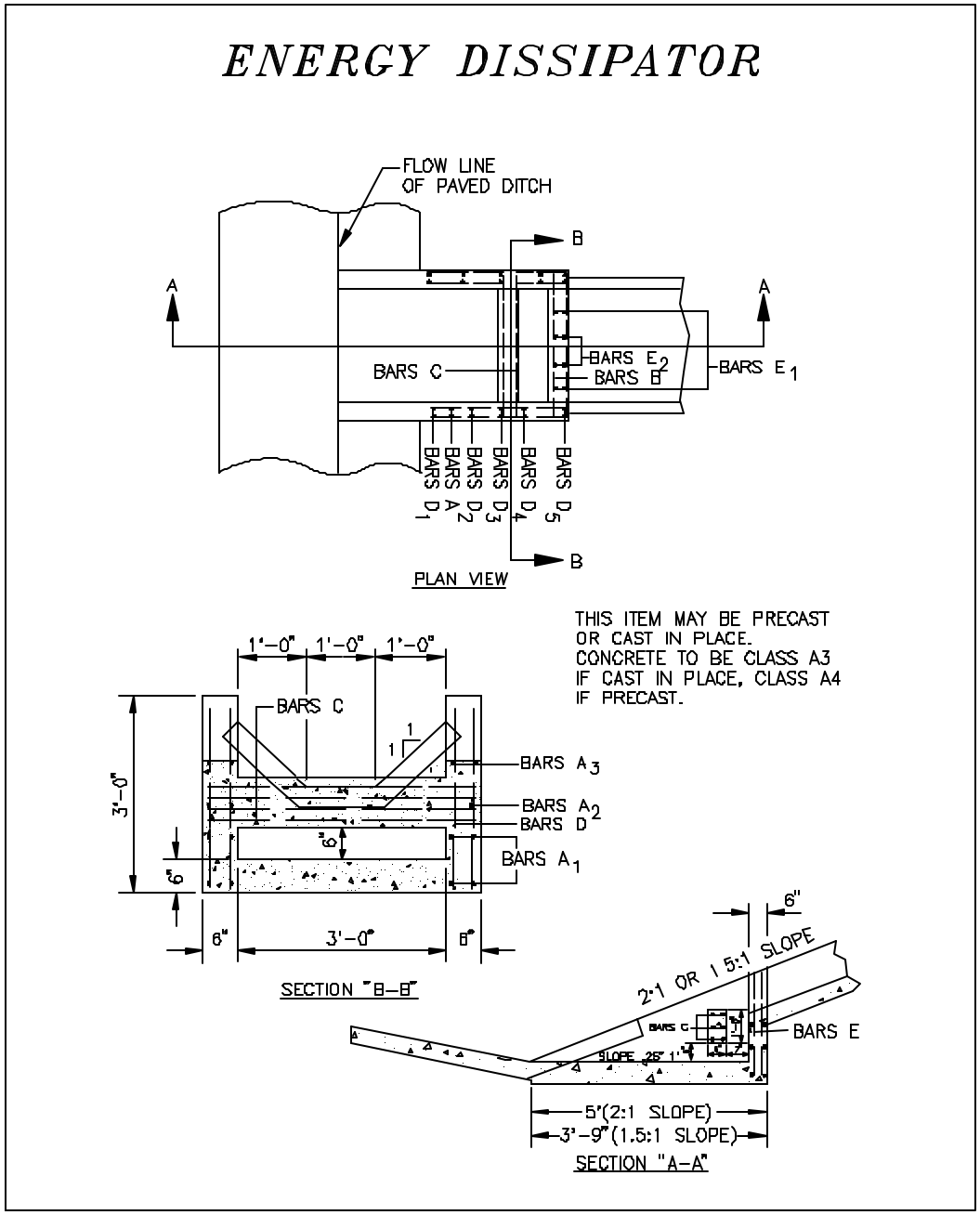


SECTION C–C

SOURCE: VDOT ROAD AND BRIDGE STANDARDS

PLATE. 3.16 –1

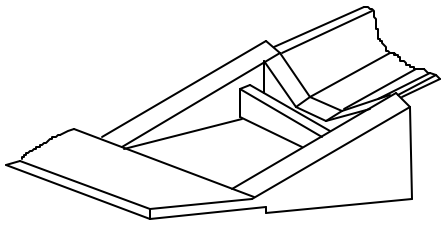
PAVED FLUME



SOURCE: VDOT ROAD AND BRIDGE STANDARDS PLATE 3.16-2

PAVED FLUME

ENERGY DISSIPATOR
(CONTINUED)



ISOMETRIC

SCHEDULE OF REINFORCING STEEL

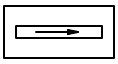
MARK	NO.	LENGTH		SIZE	SPACING C–C	SHAPE
		2:1	1.5:1			
A_1	8	2'–10"	2'–10"	3	8"	STRAIGHT
A_2	4	2'–6 1/4"	1'–10"	3	8"	STRAIGHT
A_3	4	1'–0 3/4"	0'–10"	3	8"	STRAIGHT
B	6	3'–9"	3'–9"	3	8"	STRAIGHT
C	8	3'–8"	3'–8"	3	2 1/2"	STRAIGHT
D_1	4	1'–2 1/2"	0'–8"	3	8"	STRAIGHT
D_2	4	1'–6 1/2"	1'–1 1/2"	3	8"	STRAIGHT
D_3	4	1'–10 1/2"	1'–7"	3	8"	STRAIGHT
D_4	4	2'–2 1/2"	2'–0 1/2"	3	8"	STRAIGHT
D_5	4	2'–6 1/2"	2'–6"	3	8"	STRAIGHT
E_1	4	1'–11 1/2"	1'–11 1/2"	3	8"	STRAIGHT
E_2	4	1'–5 1/2"	1'–5 1/2"	3	8"	STRAIGHT

APPROXIMATE QUANTITIES			
		CONCRETE	REINFORCING STEEL
		CU. YDS.	LBS.
ENERGY DISSIPATOR	2:1	0.7479	61.20
	1.5:1	0.5921	57.63

SOURCE: VDOT ROAD AND BRIDGE STANDARDS PLATE 3.16–3

PAVED FLUME

STD & SPEC 3.17
STORMWATER CONVEYANCE CHANNEL



SCC

Practice Description

A permanent, designed waterway, shaped, sized, and lined with appropriate vegetation or structural material, used to safely convey stormwater runoff within or away from a developing area and to provide for the conveyance of concentrated surface runoff water to a receiving channel or system without damage from erosion.

Conditions Where Practice Applies

Generally applicable to man-made channels, including roadside ditches and intermittent natural channels, which are constructed or are modified to accommodate flows generated by land development.

Construction Specifications

General:

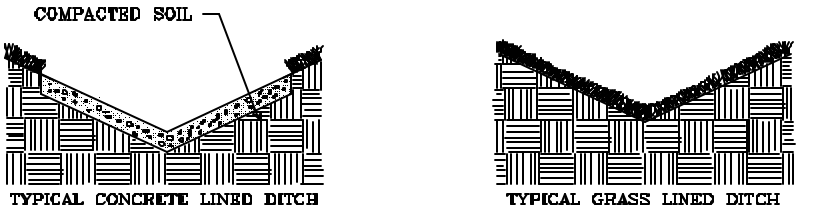
1. All trees, brush, stumps, roots, obstructions and other unsuitable material shall be removed and disposed of properly.

2. The channel shall be excavated or shaped to the proper grade and cross-section.

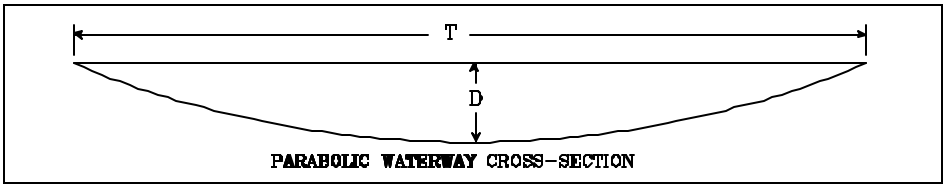
3. Any fills shall be well compacted to prevent unequal settlement.

4. Any excess soil shall be removed and disposed of properly.

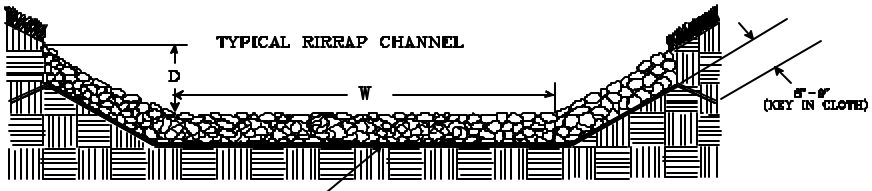
TYPICAL WATERWAY CROSS-SECTIONS



TYPICAL VEE CROSS-SECTIONS



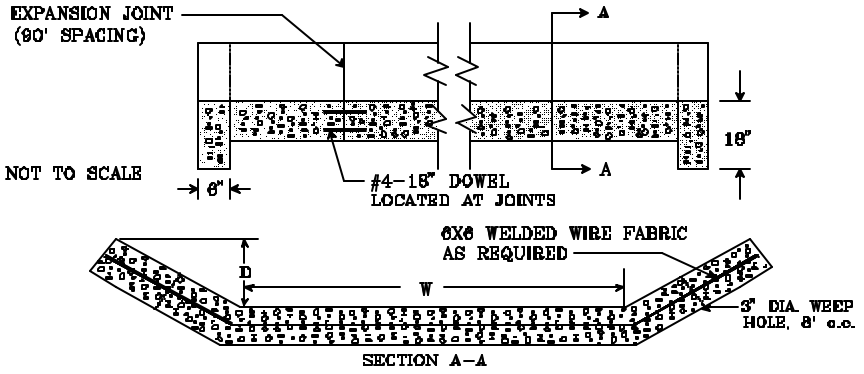
PARABOLIC WATERWAY CROSS-SECTION



FILTER CLOTH

NOTE: ALTHOUGH FILTER CLOTH IS PREFERED, A GRANULAR FILTER MAY BE SUBSTITUTED FOR FILTER CLOTH. (FOR PHYSICAL REQUIREMENTS, SEE STD. & SPEC. 3.19, RIPRAP)

TYPICAL CONCRETE CHANNEL



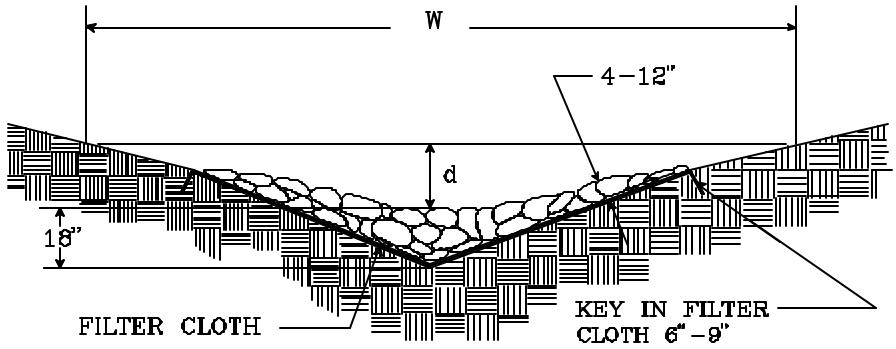
TRAPEZOIDAL WATERWAY CROSS-SECTIONS

SOURCE: VA. DSWC

PLATE 3.17-1

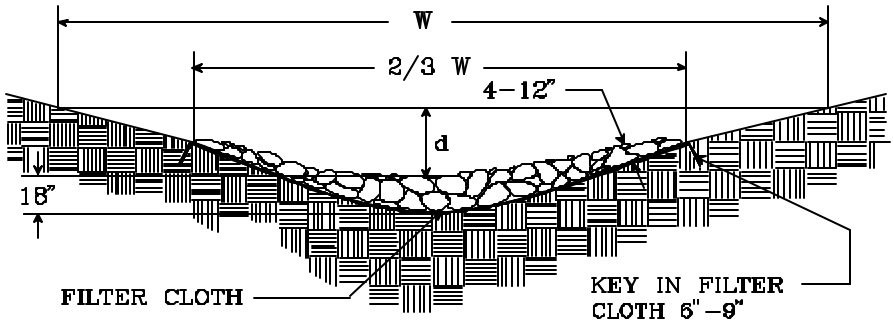
STORMWATER CONVEYANCE CHAN.

STONE-LINED WATERWAYS



V-SHAPED WATERWAY WITH STONE CENTER DRAIN

NOTE: A GRANULAR FILTER MAY BE SUBSTITUTED FOR FILTER CLOTH.



PARABOLIC WATERWAY WITH STONE CENTER DRAIN

NOTE: A GRANULAR FILTER MAY BE SUBSTITUTED FOR FILTER CLOTH.

Source: USDA-SCS

Plate 3.17-2

5. The top width of parabolic and vee-shaped, grass-lined channels shall not exceed 30 feet, and the bottom width of trapezoidal, grass lined channels shall not exceed 15 feet unless multiple or divided waterways, riprap center, or other means are provided to control meandering of low flows.

6. Where there will be a base flow in grass-lined channels, a stone center, a subsurface drain, or other suitable means to handle the base flow shall be provided. Plate 3.17-2 shows typical cross-sections for stone center channels.

7. The outlets of all channels shall be protected from erosion (see OUTLET PROTECTION**,** Std & Spec. 3.18).

Grass-lined Channels: The method used to establish grass in the ditch or channel will depend upon the severity of the conditions encountered. The methods available for grass establishment are set forth in PERMANENT SEEDING, Std. & Spec. 3.32, and SODDING, Std. & Spec. 3.33. Below is a table which can be used to help choose a successful grass establishment technique, if any of the four conditions is exceeded, the next establishment technique below must be used.

Table 3.17 - A

GRASS ESTABLISHMENT ALTERNATIVES

Establishment Technique	Conditions
1. (a) Seeding with straw mulch and tack coat. (b) Establishing Bermudagrass by sprigging.	1. Slopes less than 5%. 2. Velocity 3 feet per second or less. 3. Majority of drainage can be diverted away from channel during germination and establishment. 4. Erosion-resistant soils.
2. Seeding with straw mulch and jute mesh or other soil stabilization blankets. (i.e., Treatment-1)	1. Slopes less than 5%. 2. Velocity 4 feet per second or less. 3. Majority of drainage can not be diverted away from channel during germination and establishment. 4. Moderately erodible soil
3. Sodding or use of soil stabilization matting (i.e.,Treatment - 2).	1. Slopes greater than 5%. 2. Velocity between 5 feet per second and 6 feet per second. 3. Majority of drainage can not be diverted away from channel during germination and establishment. 4. Highly erodible soil

1. (a) Seeding with straw mulch and tack coat. All seeding shall be done in accordance with PERMANENT SEEDING, Std & Spec. 3.32. When mulching, use 2 tons/acre small grain straw with an acceptable tacking agent. Also refer to MULCHING, Std. & Spec. 3.35.

   (b) Bermudagrass establishment by sprigging. Establish Bermudagrass in accordance with BERMUDAGRASS ESTABLISHMENT, Std. & Spec. 3.34 (E&S Handbook). Irrigation water must be available during the first 4 weeks. Divert drainage away from channel during the first three weeks of the establishment period by using temporary dikes, silt fencing, or straw bale barriers.

2. Seeding with straw mulch and jute mesh or other soil stabilization blankets. In addition to (1a) above, straw mulch may be secured with netting to form a soil stabilization blanket. If using a light plastic or paper erosion netting, 1-1/2 to 2 tons/acre of straw is appropriate. Care should be taken to staple the mesh or blankets according to specifications in, Std. & Spec. 3.36, SOIL STABILIZATION BLANKETS & MATTING, Combination blankets, used alone, are also acceptable mulches for waterways.

3. Sodding or use of Soil Stabilization Matting. Sod shall be installed as per Std & Spec, 3.33. Soil stabilization matting shall be installed as per Std. & Spec 3.36, SOIL STABILIZATION BLANKETS & MATTING.

Riprap-lined Channels

Riprap shall be installed in accordance with RIPRAP, Std. & Spec. 3.19.

Concrete-lined Channels

Concrete-lined channels must be constructed in accordance with all applicable VDOT specifications. The following items highlight those specifications:

1. The subgrade should be moist at the time the concrete is poured.

2. Traverse joints for crack control should be provided at approximately 20-foot intervals and when more than 45 minutes elapses between the times of consecutive concrete placements. All sections should be at least 6 feet long. Crack control joints may be formed by using a 1/8-inch thick removable template, by scoring or sawing to a depth of at least 3/4 inch or by an approved "leave-in" type insert.

3. Expansion joints shall be installed every 100 feet.

Maintenance

Grass-lined Channels: During the initial establishment, grass-lined channels should be repaired immediately and grass re-established if necessary. After grass has become established, the channel should be checked periodically to determine if the grass is withstanding flow velocities without damage. If the channel is to be mowed, it should be done in a manner that will not damage the grass.

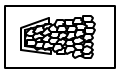
Riprap-lined Channels: Riprap-lined channels should be checked periodically to ensure that scour is not occurring beneath fabric underlining of the riprap layer. The channel should also be checked to determine that the stones are not dislodged by large flows.

Concrete-lined Channels: Concrete-lined channels should be checked periodically to ensure that there is no undermining of the channel. Particular attention should be paid to the outlet of the channel. If scour is occurring at the outlet, appropriate outlet protection shall be installed. See OUTLET PROTECTION, Std. & Spec. 3.18.

Sediment Deposition: If the channel is below a high sediment-producing area, sediment should be trapped before it enters the channel.

Field experience has demonstrated that many newly constructed conveyance channels become damaged and require costly repairs as a result of improper upslope controls. If sediment is deposited in a grass-lined channel, it should be removed promptly to prevent damage to the grass. Sediment deposited in riprap and concrete-lined channels should be removed when it reduces the capacity of the channel.

STD & SPEC 3.18
OUTLET PROTECTION



OP

Practice Description

Structurally lined aprons or other acceptable energy dissipating devices placed at the outlets of pipes or paved channel sections, used to prevent scour at stormwater outlets, to protect the outlet structure, and to minimize the potential for downstream erosion by reducing the velocity and energy of concentrated stormwater flows.

Conditions Where Practice Applies

This practice is applicable to the outlets of all pipes and engineered channel sections.

Construction Specifications

1. Apron dimensions: shall be specified in the plan.

2. Bottom grade: The apron shall be constructed with no slope along its length (0.0%grade). The invert elevation of the downstream end of the apron shall be equal to the elevation of the invert of the receiving channel. There shall be no overfall at the end of the apron.

3. Side slopes: If the pipe discharges into a well-defined channel, the side slopes of the channel shall not be steeper than 2:1(horizontal: vertical).

4. Alignment: The apron shall be located so there are not bends in the horizontal alignment.

5. Materials: The apron may be lined with riprap, grouted iprap, concrete, or gabion baskets. The median sized stone for riprap shall be specified in the plan.

   The graduation, quality and placement of riprap shall conform to Std. & Spec. 3.19, RIPRAP.

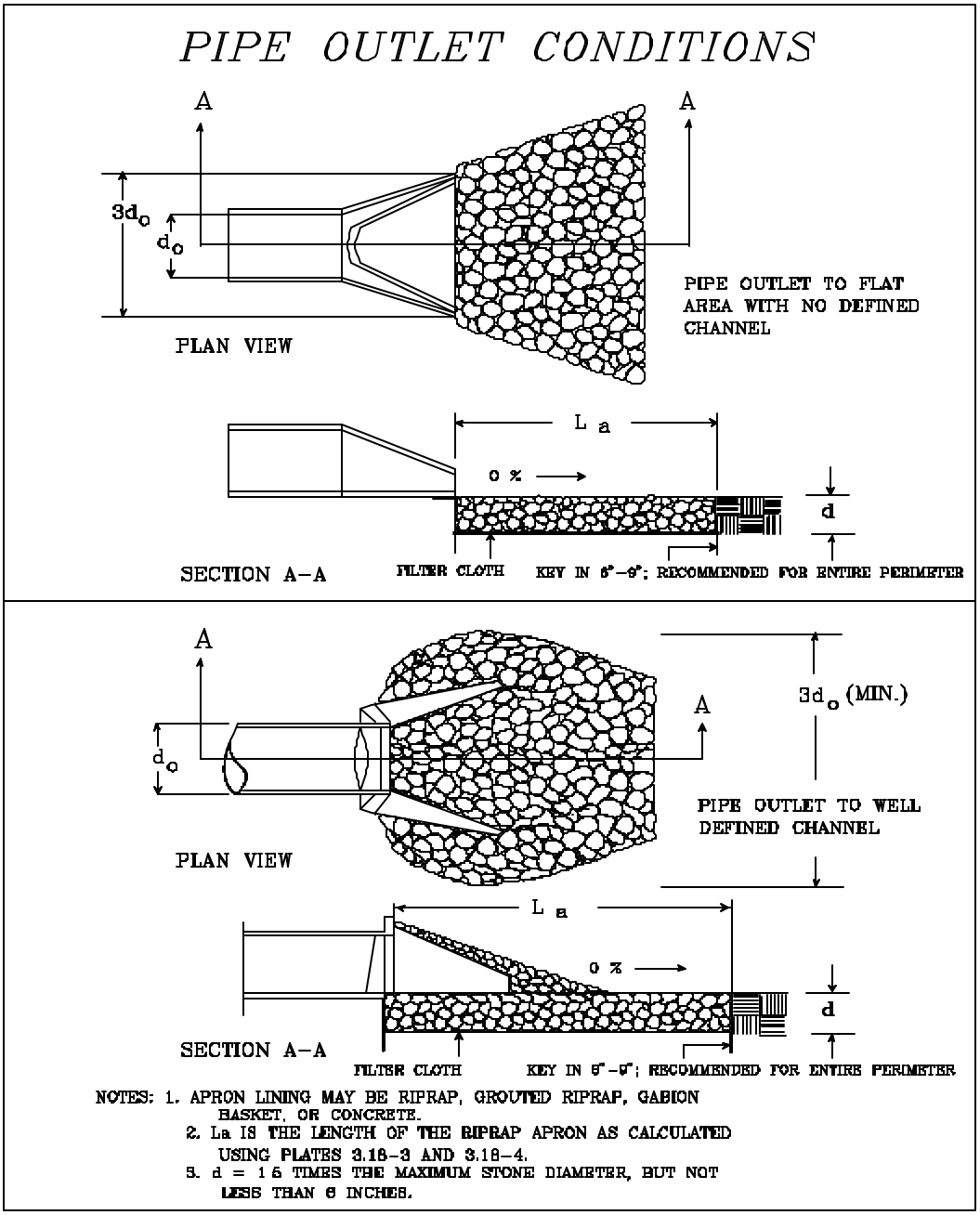
6. Filter cloth: In all cases, filter cloth shall be placed between the riprap and the underlying soil to prevent soil movement into and through the riprap. The material must meet or exceed the physical properties for filter cloth found in Std. & Spec. 3.19, RIPRAP. See Plate 3.18-1 for orientation details.

7. Grouted Riprap: Grout for grouted riprap shall consist of one part Portland Cement for 3 parts sand, thoroughly mixed with water to produce grout having a thick, creamy consistency. After the stones are in place, spaces between them shall be filled with grout to a depth of at least 6 inches. The portion below the top 6 inches may be choked with fine material.

8. Concrete Aprons: shall be installed according to specifications and details on the plan.

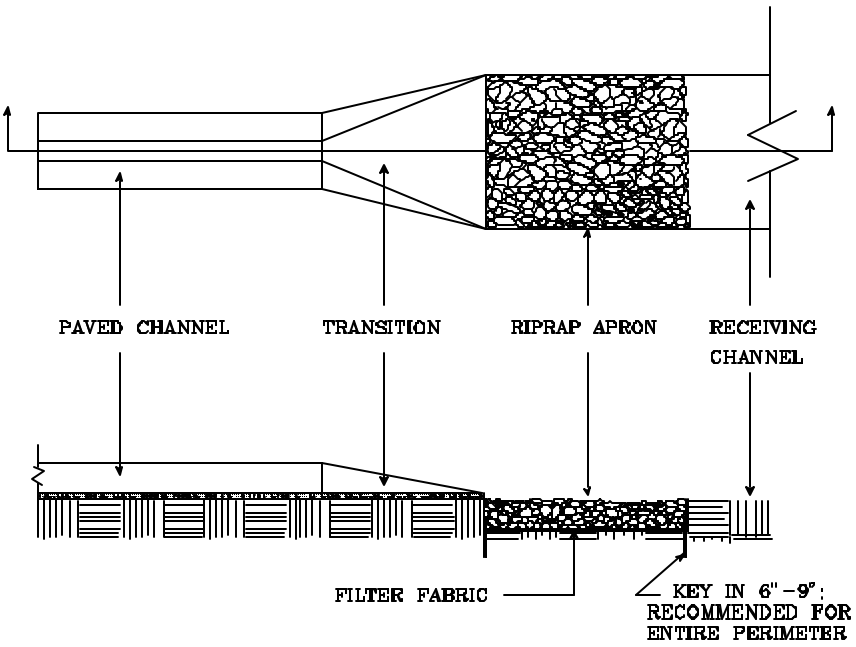
9. Paved Channel Outlets: The end of the paved channel shall merge smoothly with receiving channel section. There shall be no overfall at the end of the paved section. Where the bottom width of the paved channel is narrower than the bottom width of the receiving channel, a transition section shall be provided. (See Plate 3.18-2).

OUTLET PROTECTION



Source: Va. DSWC Plate 3.18–1

PAVED CHANNEL OUTLET



NOTES:

1. RIPRAP APRON REDUCES THE FLOW VELOCITY BELOW THE PERMISSIBLE VELOCITY OF THE NATURAL RECEIVING CHANNEL.
2 TRANSITION SIDE DIVERGENCE IS 1 IN 3F, WHERE

$$F = \text{FROUDE NUMBER} = \frac{V}{\sqrt{gd}}, \text{ WHERE}$$

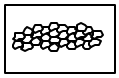
V = VELOCITY AT THE BEGINING OF THE TRANSITION
d = DEPTH OF FLOW AT THE BEGINING OF THE TRANSITION

$g = 32.2 \text{ ft./sec}^2$

SOURCE: VA. DSWC PLATE 3.18-2

OUTLET PROTECTION

STD & SPEC 3.19
RIPRAP



RR

Practice Description

A permanent, erosion-resistant ground cover of large, loose, angular stone with filter fabric or granular underlining, used to protect the soil from the erosive forces of concentrated runoff, slow the velocity of concentrated runoff while enhancing the potential for infiltration; also utilized to stabilize slopes with seepage problems and/or non-cohesive soils.

Conditions Where Practice Applies

Wherever soil and water interface and the soil conditions, water turbulence and velocity, expected vegetative cover, etc., are such that the soil may erode under the design flow conditions. Riprap may be used, as appropriate, at stormdrain outlets, on channel banks and/or bottoms, roadside ditches, drop structures and at the toe of slopes, as transition from concrete channels to vegetated channels.

Construction Specifications

1. Quality of Stone: Stone for riprap shall consist of field stone or rough unhewn quarry stone of approximately rectangular shape. The stone shall be hard and angular and of such quality that it will not disintegrate on exposure to water or weathering and it shall be suitable in all respects for the purpose intended. The specific gravity of the individual stones shall be at least 2.5.

   Rubble concrete may be used provided it has a density of at least 150 pounds per cubic foot, and otherwise meets the requirements of this standard and specification.

   Size and weight of stone utilized must correspond to plan specifications. The following weight analysis of graded riprap may be used to help verify the class or type of stone which is to be placed:

TABLE 3.19 - A
GRADED RIPRAP - WEIGHT ANALYSIS

Riprap Class/Type	Weight Range*(lbs.)	Requirements for Stone Mixture
Class AI	25-75	Max.10% >75 lbs.
Class I	50-150	60% > 100 lbs.
Class II	150-500	50% > 300 lbs.
Class III	500-1,500	50% > 900 lbs.
Type I	1,500-4,000	Av. wt.=2,000lbs.
Type II	6,000-20,000	Av. wt.=8,000lbs.

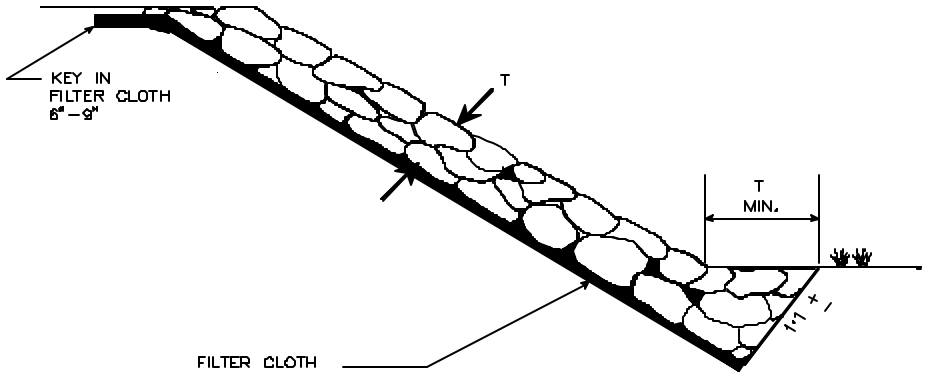
Source: Adapted from VDOT Road and Bridge Specifications

2. Subgrade Preparation: The subgrade for the riprap or filter shall be prepared to the required lines and grades. Any fill required in the subgrade shall be compacted to a density approximately that of the surrounding undisturbed material. Brush, trees, stumps and other objectionable material shall be removed.

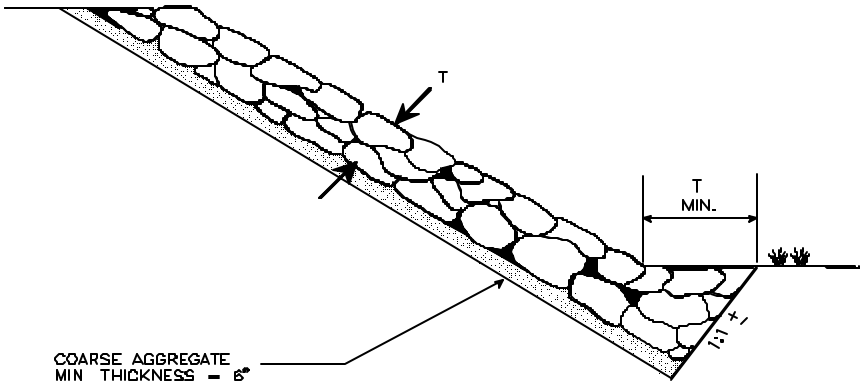
3. Filter Fabric or Granular Filter: Placement of the filter fabric should be done immediately after slope preparation. For granular filters, the stone should be spread in a uniform layer to the specified depth (normally 6 inches). Where more than one layer of filter material is used, the layer should be spread so that there is minimal mixing of the layers.

TOE REQUIREMENTS FOR BANK STABILIZATION

FILTER CLOTH UNDERLINER (PREFERRED)



GRANULAR FILTER



SOURCE: Adapted from VDOT Drainage Manual PLATE. 3.19–1

RIPRAP

When installing geotextile filter cloths, the cloth should be placed directly on the prepared slope. The edges of the sheets should overlap by at least 12 inches. Anchor pins, 15 inches long, should be spaced every 3 feet along the overlap. The upper and lower ends of the cloth should be buried at least 12 inches. Care should be taken not to damage the cloth when placing the riprap. If damage occurs, that sheet should be removed and replaced. For large stone (Class II or greater), a 6-inch layer of granular filter will be necessary to prevent damage to the cloth. See Table 3.19-B for physical requirements of filter cloth to be used with riprap.

TABLE 3.19 - B
REQUIREMENTS FOR FILTER FABRIC
USED WITH RIPRAP

Physical Property	Test Method	Requirements
Equivalent Opening size	Corps of Engineers CWO 2215-77	Equal or greater than U.S. No. 50 sieve
Tensile Strength* @ 20% (maximum)	VTM – 52	30 lbs./linear in. (minimum)
Puncture Strength	ASTM D751*	80 lbs. (minimum)

*Tensile testing machine with ring clamp, steel ball replaced with 5/16" diameter solid steel cylinder with hemispherical tip centered within the ring clamp.

Seams shall be equal in strength to basic material.

Additional fabric material or non-corrosive steel wire may be incorporated into the fabric to increase overall strength.

Source: VDOT Road and Bridge Specifications

Stone Placement: Placement of riprap should follow immediately after placement of the filter. The riprap should be placed so that it produces a dense well-graded mass of stone with a minimum of voids. The desired distribution of stones throughout the mass may be obtained by selective loading at the quarry, controlled dumping of successive loads during final placing, or by a combination of these methods.

The riprap should be placed to its full thickness in one operation. The riprap should not be placed in layers. The riprap should not be placed by dumping into chutes or similar methods that are likely to cause segregation of the various stone sizes. Care should be taken not to dislodge the underlying material when placing the stones.

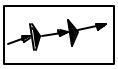
The finished slope should be free of pockets of small stone or clusters of large stones. Hand placing may be necessary to achieve the required grades and a good distribution of stone sizes. Final thickness of the riprap blanket should be within plus or minus 1/4 of the specified thickness.

Maintenance

Once a riprap installation has been completed, it should require very little maintenance. It should, however, be inspected periodically to determine if high flows have caused scour beneath the riprap or filter fabric or dislodged any of the stone. Care must be taken to properly control sediment-laden construction runoff which may drain to the point of the new installation. If repairs are needed, they should be accomplished immediately.

RIPRAP

STD & SPEC 3.20
ROCK CHECK DAMS



CD

Practice Description

Small temporary stone dams constructed across a swale or drainage ditch, to reduce the velocity of concentrated stormwater flows, thereby reducing erosion of the swale or ditch. This practice also traps sediment generated from adjacent areas or the ditch itself, mainly by ponding of the stormwater runoff. Field experience has shown it to perform more effectively than silt fence or straw bales in the effort to stabilize "wet-weather" ditches.

Conditions Where Practice Applies

This practice, utilizing a combination of stone sizes, is limited to use in small open channels that drain 10 acres or less. It should not be used in a live stream as the objective should be to protect the live watercourse. Some specific applications include:

1. Temporary ditches or swales which, because of their short length of service, cannot receive a non-erodible lining but still need protection to reduce erosion.

2. Permanent ditches or swales which, for some reason, cannot receive a permanent non-erodible lining for an extended period of time.

3. Either temporary or permanent ditches or swales which need protection during the establishment of grass linings.

4. An aid in the sediment trapping strategy for a construction site.

This practice is not a substitute for major perimeter trapping measures such as a SEDIMENT TRAP (Std. & Spec. 3.13) or a SEDIMENT BASIN (Std. & Spec. 3.14).

Construction Specifications

1. The drainage area of the ditch or swale being protected shall not exceed 2 acres when VDOT #1 Coarse Aggregate is used alone and shall not exceed 10 acres when a combination of Class I Riprap (added for stability) and VDOT #1 Coarse Aggregate is used. Refer to Plate 3.20-1 for orientation of stone and a cross-sectional view of the measure. An effort should be made to extend the stone to the top of channel banks.

2. However, the maximum height of the dam shall be 3.0 feet.

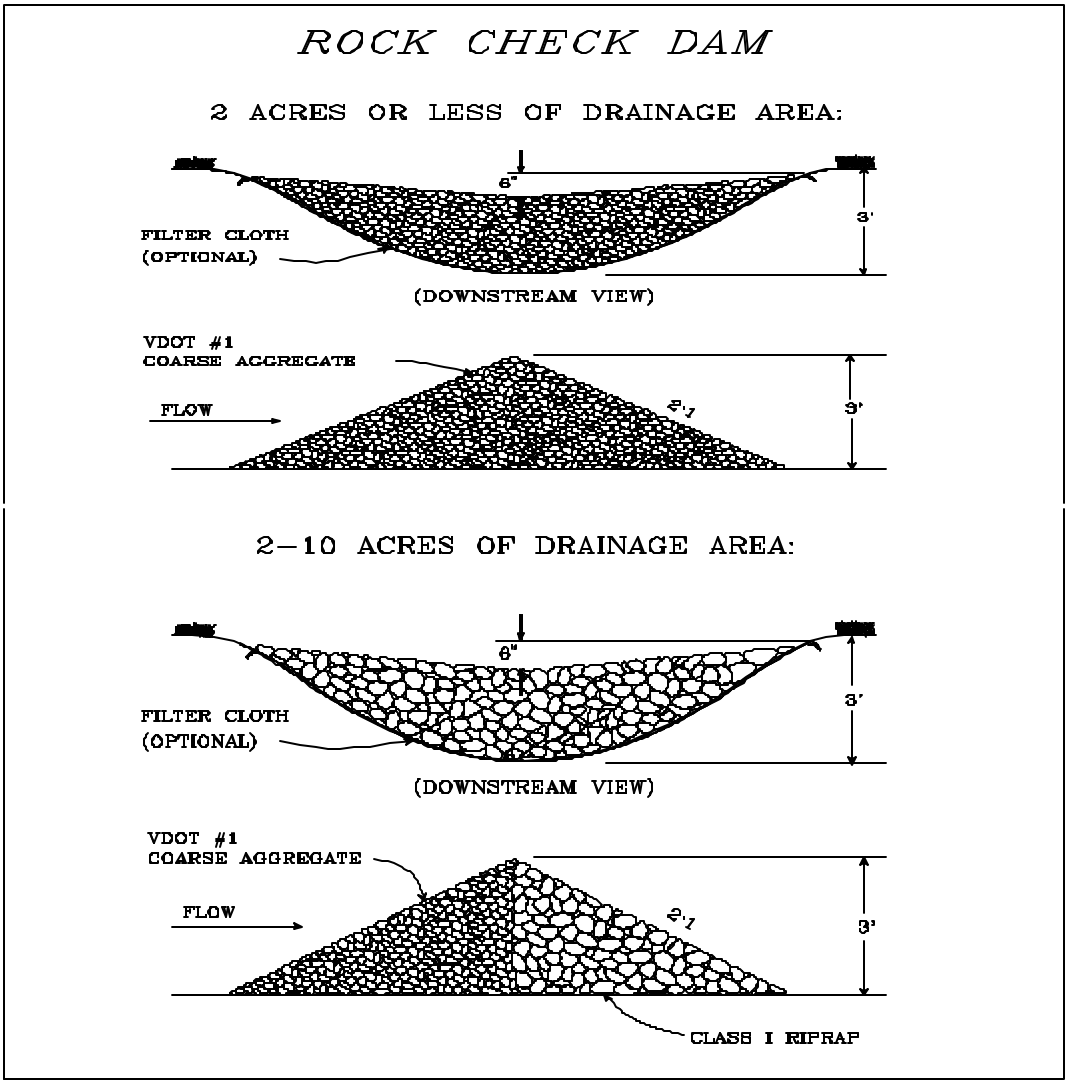
3. The center of the check dam must be at least 6 inches lower than the outer edges. Field experience has shown that many dams are not constructed to promote this "weir" effect. Stormwater flows are then forced to the stone-soil interface, thereby promoting scour at that point and subsequent failure of the structure to perform its intended function.

4. For added stability, the base of the check dam can be keyed into the soil approximately 6 inches.

5. The maximum spacing between the dams should be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam (see Plate 3.20-2).

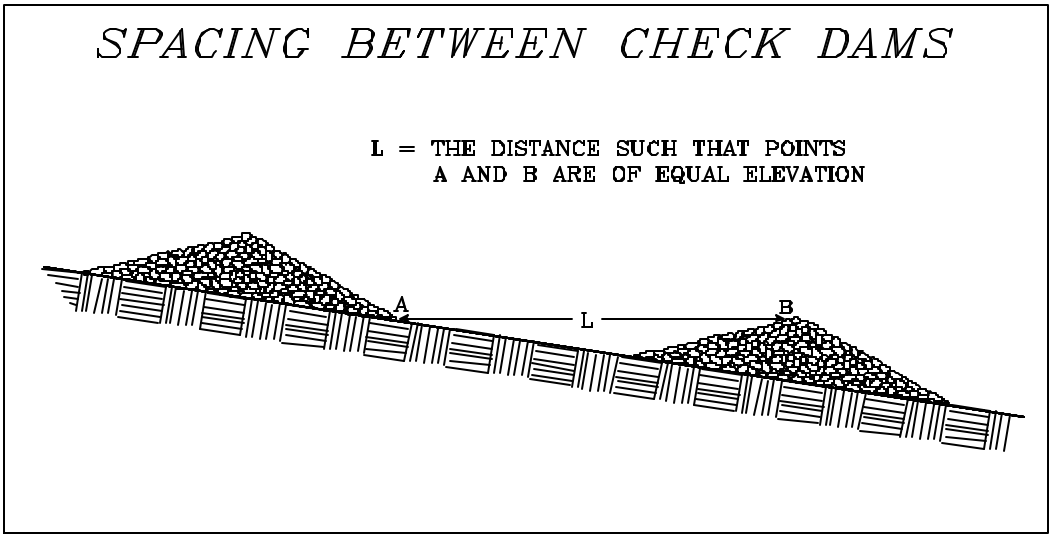
6. Stone should be placed according to the configuration in Plate 3.20-1. Hand or mechanical placement will be necessary to achieve complete coverage of the ditch or swale and to insure that the center of the dam is lower than the edges.

ROCK CHECK DAMS



SOURCE: VA DSWC PLATE. 3.20-1

ROCK CHECK DAMS



SOURCE: VA. DSWC PLATE. 3.20-2

7. Filter cloth may be used under the stone to provide a stable foundation and to facilitate the removal of the stone. See Std. and Spec. 3.19, RIPRAP, for required physical properties of the filter cloth.

Sediment Removal

Sediment should be removed from behind the check dam when it has accumulated to one half of the original height of the dam.

Removal of Practice

Unless they will be incorporated into a permanent stormwater management control, check dams must be removed when their useful life has been completed. In temporary ditches and swales, check dams should be removed and the ditch filled in when they are no longer needed. In permanent structures, check dams should be removed when a permanent lining can be installed. In the case of grass-lined ditches, check dams should be removed when the grass has matured sufficiently to protect the ditch or swale. The area beneath the check dams should be seeded and mulched immediately after they are removed. The use of filter cloth underneath the stone will make the removal of the stone easier.

ROCK CHECK DAMS

Maintenance

Check dams should be checked for sediment accumulation after each runoff-producing storm event. Sediment should be removed when it reaches one half of the original height of the measure.

Regular inspections should be made to insure that the center of the dam is lower than the edges. Erosion caused by high flows around the edges of the dam should be corrected immediately.

ROCK CHECK DAMS

STD & SPEC 3.24
TEMPORARY VEHICULAR STREAM CROSSING

SC

Practice Description

A temporary structural span installed across a flowing watercourse for use by construction traffic. Structures may include bridges, round pipes, pipe arches, or oval pipes, which provide a means for construction traffic to cross flowing streams without damaging the channel or banks, and keep sediment generated by construction traffic out of the stream.

Conditions Where Practice Applies

Generally applicable to flowing streams with drainage areas less than 1 square mile. Structures that must handle flow from larger drainage areas should be designed by methods that more accurately define the actual hydrologic and hydraulic parameters that will affect the functioning of the structure.

Construction Specifications

1. Temporary Bridge Crossing (see Plate 3.24-1)

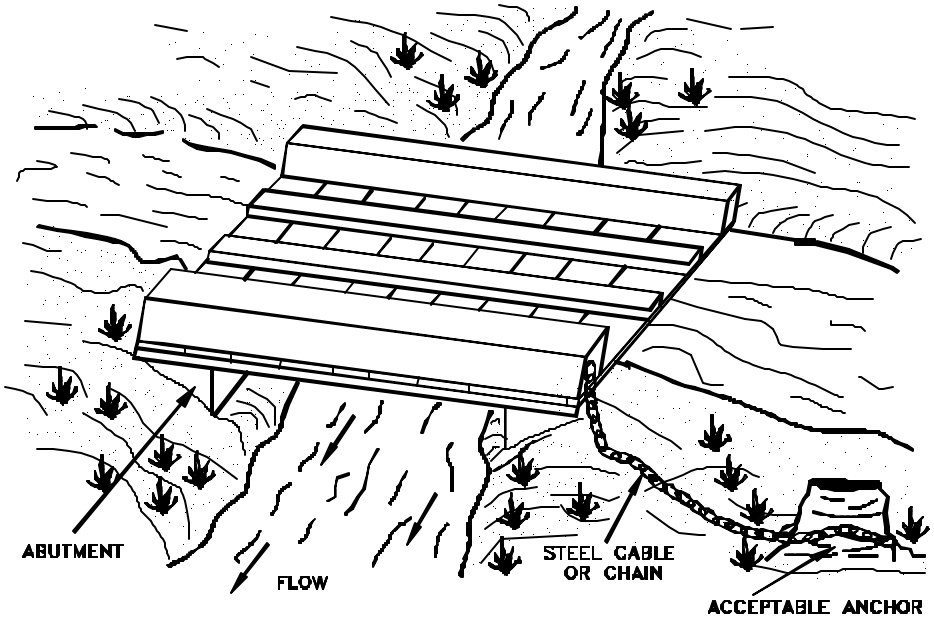
    a. Clearing and excavation of the stream bed and banks shall be kept to a minimum.

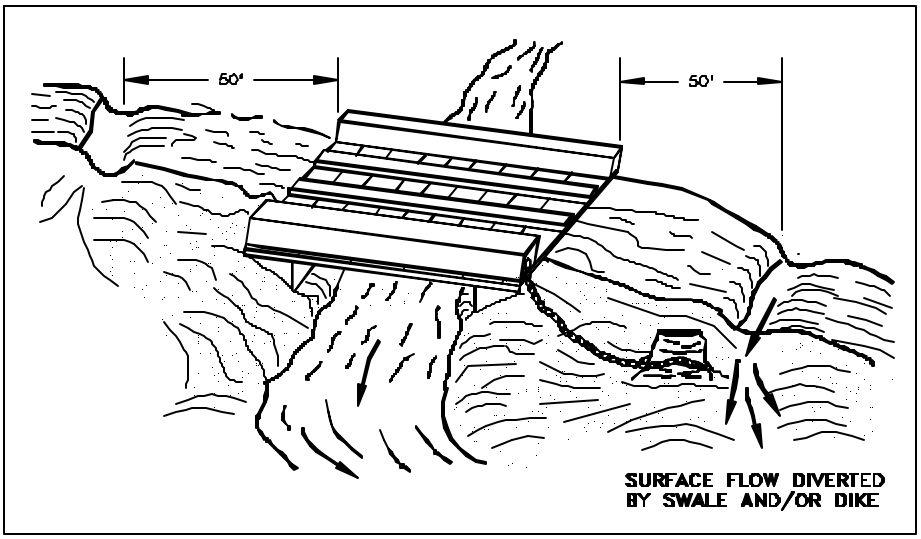
    b. The temporary bridge structure shall be constructed at or above bank elevation to prevent the entrapment of floating materials and debris.

    c. Abutments shall be placed parallel to and on stable banks.

TEMP. VEHICULAR STREAM CROSS.

TEMPORARY BRIDGE CROSSING

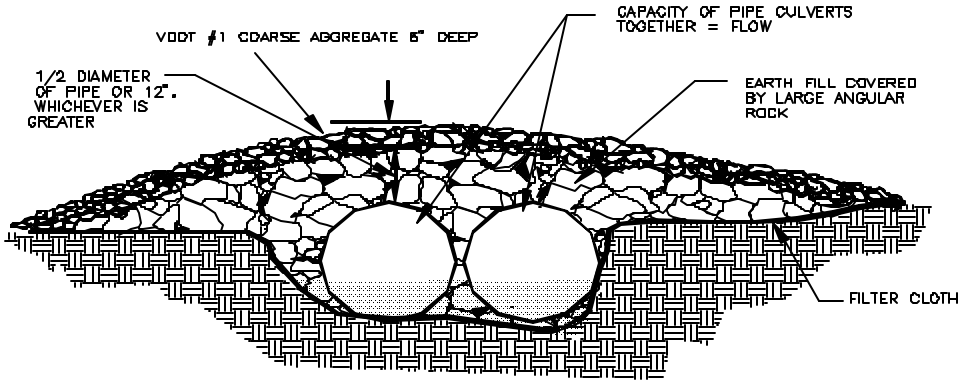




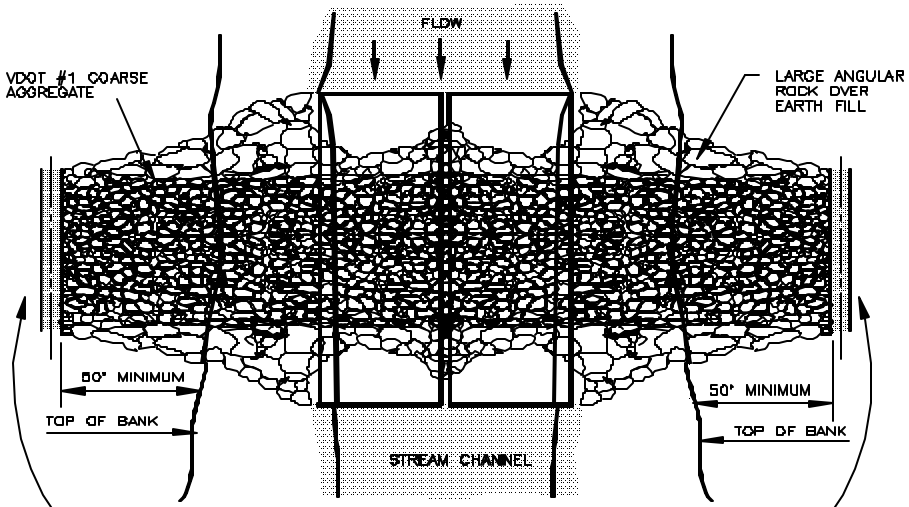
SOURCE: 1983 Maryland Standards and Specifications for Soil Erosion and Sediment Control PLATE. 3.24–1

TEMP. VEHICULAR STREAM CROSS.

TEMPORARY CULVERT CROSSING



ELEVATION



PLAN VIEW

SOURCE: VA. DSWC PLATE. 3.24-2

TEMP. VEHICULAR STREAM CROSS.

d. Bridges shall be constructed to span the entire channel. If the channel width exceeds 8 feet (as measured from top-of-bank to top-of-bank), then a footing, pier or bridge support may be constructed within the waterway. One additional footing, pier or bridge support will be permitted for each additional 8-foot width of the channel. No footing, pier or bridge support, however, will be permitted within the channel for waterways which are less than 8 feet wide.

e. Stringers shall either be logs, sawn timber, prestressed concrete beams, metal beams, or other approved materials.

f. Decking materials shall be of sufficient strength to support the anticipated load. All decking members shall be placed perpendicular to the stringers, butted tightly, and securely fastened to the stringers. Decking materials must be butted tightly to prevent any soil material tracked onto the bridge from falling into the waterway below.

g. Run planking (optional) shall be securely fastened to the length of the span. One run plank shall be provided for each track of the equipment wheels. Although run planks are optional, they may be necessary to properly distribute loads.

h. Curbs or fenders may be installed along the outer sides of the deck. Curbs or fenders are an option which will provide additional safety.

i. Bridges shall be securely anchored at only one end using steel cable or chain. Anchoring at only one end will prevent channel obstruction in the event that floodwaters float the bridge. Acceptable anchors are large trees, large boulders, or driven steel anchors. Anchoring shall be sufficient to prevent the bridge from floating downstream and possibly causing an obstruction to the flow.

j. All areas disturbed during installation shall be stabilized within 7 calendar days of that disturbance in accordance with MS #1.

TEMP. VEHICULAR STREAM CROSS.

k. When the temporary bridge is no longer needed, all structures including abutments and other bridging materials should be removed immediately.

l. Final clean-up shall consist of removal of the temporary bridge from the waterway, protection of banks from erosion, and removal of all construction materials. All removed materials shall be stored outside flood plain of the stream. Removal of the bridge and clean-up of the area shall be accomplished without construction equipment working in the waterway channel.

2. Temporary Culvert Crossing

a. Clearing and excavation of the stream bed and banks shall be kept to a minimum.

b. The invert elevation of the culvert shall be installed on the natural streambed grade to minimize interference with fish migration.

c. Filter cloth shall be placed on the streambed and streambanks prior to placement of the pipe culvert(s) and aggregate. The filter cloth shall cover the streambed and extend a minimum of six inches and a maximum of one foot beyond the end of the culvert and bedding material. Filter cloth reduces settlement and improves crossing stability. See Std. & Spec. 3.19, RIPRAP, for required physical qualities of the filter cloth.

d. The culvert(s) shall extend a minimum of one foot beyond the upstream and downstream toe of the aggregate placed around the culvert. In no case shall the culvert exceed 40 feet in length.

e. The culvert(s) shall be covered with a minimum of one foot of aggregate. If multiple culverts are used, they shall be separated by at least 12 inches of compacted aggregate fill. At a minimum, the bedding and fill material used in the construction of the temporary access culvert crossings shall conform with the aggregate requirements cited in part "i" under "Temporary Culvert Crossing."

TEMP. VEHICULAR STREAM CROSS.

f. When the crossing has served its purpose, all structures including culverts, bedding and filter cloth materials shall be removed. Removal of the structure and clean-up of the area shall be accomplished without construction equipment working in the waterway channel.

g. Upon removal of the structure, the stream shall immediately be shaped to its original cross-section and properly stabilized.

Maintenance

Both structures shall be inspected after every rainfall and at least once a week, whether it has rained or not, and all damages repaired immediately.

TEMP. VEHICULAR STREAM CROSS.

STD & SPEC 3.24
TEMPORARY VEHICULAR STREAM CROSSING

SC

Practice Description

A temporary structural span installed across a flowing watercourse for use by construction traffic. Structures may include bridges, round pipes, pipe arches, or oval pipes, which provide a means for construction traffic to cross flowing streams without damaging the channel or banks, and keep sediment generated by construction traffic out of the stream.

Conditions Where Practice Applies

Generally applicable to flowing streams with drainage areas less than 1 square mile. Structures that must handle flow from larger drainage areas should be designed by methods that more accurately define the actual hydrologic and hydraulic parameters that will affect the functioning of the structure.

Construction Specifications

1. Temporary Bridge Crossing (see Plate 3.24-1)

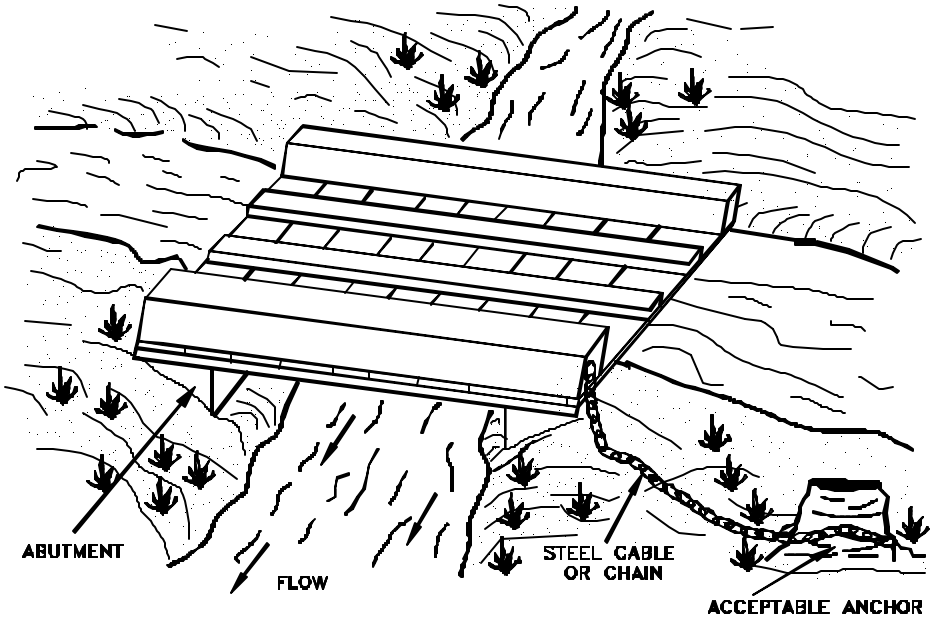
    a. Clearing and excavation of the stream bed and banks shall be kept to a minimum.

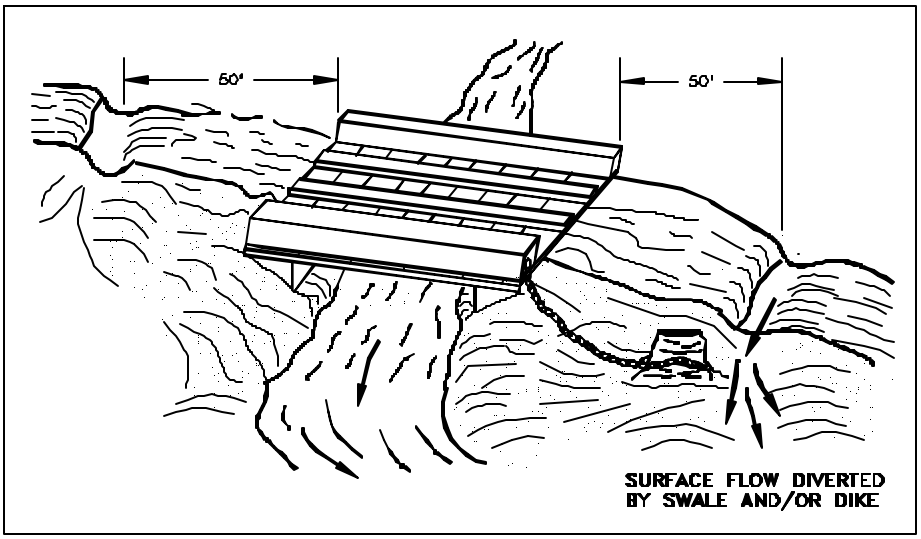
    b. The temporary bridge structure shall be constructed at or above bank elevation to prevent the entrapment of floating materials and debris.

    c. Abutments shall be placed parallel to and on stable banks.

TEMP. VEHICULAR STREAM CROSS.

TEMPORARY BRIDGE CROSSING

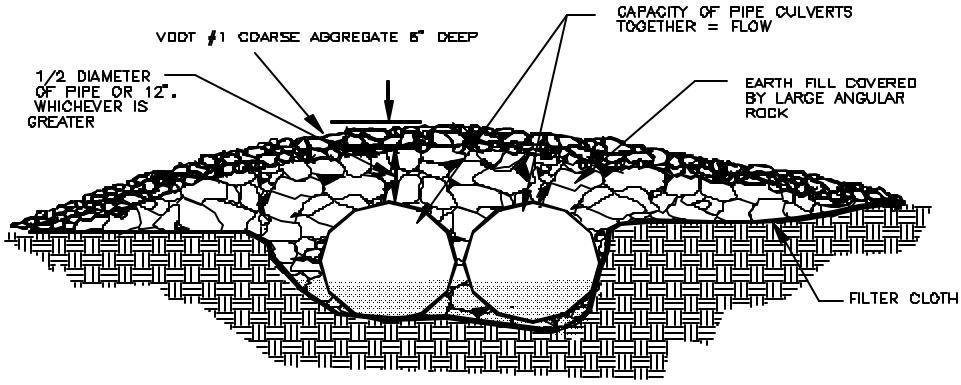




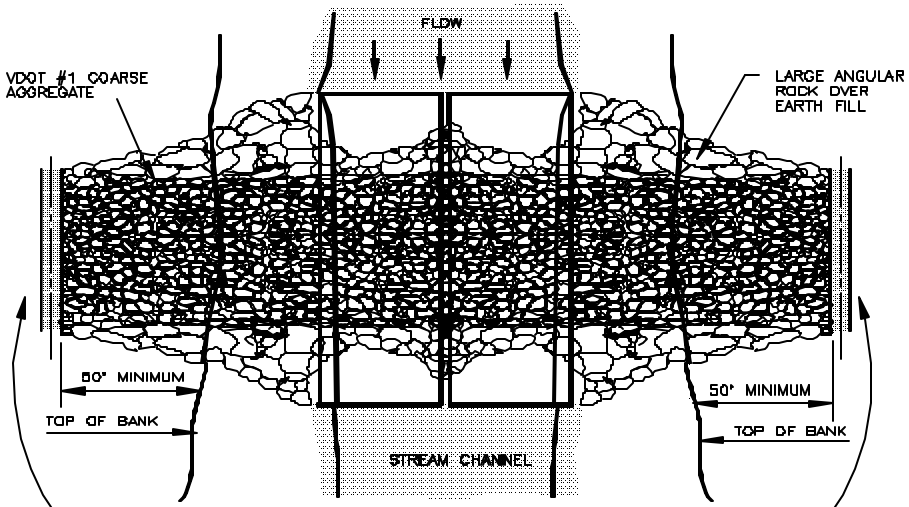
SOURCE: 1983 Maryland Standards and Specifications for Soil Erosion and Sediment Control PLATE. 3.24–1

TEMP. VEHICULAR STREAM CROSS.

TEMPORARY CULVERT CROSSING



ELEVATION



PLAN VIEW

SOURCE: VA. DSWC PLATE. 3.24-2

TEMP. VEHICULAR STREAM CROSS.

d. Bridges shall be constructed to span the entire channel. If the channel width exceeds 8 feet (as measured from top-of-bank to top-of-bank), then a footing, pier or bridge support may be constructed within the waterway. One additional footing, pier or bridge support will be permitted for each additional 8-foot width of the channel. No footing, pier or bridge support, however, will be permitted within the channel for waterways which are less than 8 feet wide.

e. Stringers shall either be logs, sawn timber, prestressed concrete beams, metal beams, or other approved materials.

f. Decking materials shall be of sufficient strength to support the anticipated load. All decking members shall be placed perpendicular to the stringers, butted tightly, and securely fastened to the stringers. Decking materials must be butted tightly to prevent any soil material tracked onto the bridge from falling into the waterway below.

g. Run planking (optional) shall be securely fastened to the length of the span. One run plank shall be provided for each track of the equipment wheels. Although run planks are optional, they may be necessary to properly distribute loads.

h. Curbs or fenders may be installed along the outer sides of the deck. Curbs or fenders are an option which will provide additional safety.

i. Bridges shall be securely anchored at only one end using steel cable or chain. Anchoring at only one end will prevent channel obstruction in the event that floodwaters float the bridge. Acceptable anchors are large trees, large boulders, or driven steel anchors. Anchoring shall be sufficient to prevent the bridge from floating downstream and possibly causing an obstruction to the flow.

j. All areas disturbed during installation shall be stabilized within 7 calendar days of that disturbance in accordance with MS #1.

TEMP. VEHICULAR STREAM CROSS.

k. When the temporary bridge is no longer needed, all structures including abutments and other bridging materials should be removed immediately.

l. Final clean-up shall consist of removal of the temporary bridge from the waterway, protection of banks from erosion, and removal of all construction materials. All removed materials shall be stored outside flood plain of the stream. Removal of the bridge and clean-up of the area shall be accomplished without construction equipment working in the waterway channel.

2. Temporary Culvert Crossing

a. Clearing and excavation of the stream bed and banks shall be kept to a minimum.

b. The invert elevation of the culvert shall be installed on the natural streambed grade to minimize interference with fish migration.

c. Filter cloth shall be placed on the streambed and streambanks prior to placement of the pipe culvert(s) and aggregate. The filter cloth shall cover the streambed and extend a minimum of six inches and a maximum of one foot beyond the end of the culvert and bedding material. Filter cloth reduces settlement and improves crossing stability. See Std. & Spec. 3.19, RIPRAP, for required physical qualities of the filter cloth.

d. The culvert(s) shall extend a minimum of one foot beyond the upstream and downstream toe of the aggregate placed around the culvert. In no case shall the culvert exceed 40 feet in length.

e. The culvert(s) shall be covered with a minimum of one foot of aggregate. If multiple culverts are used, they shall be separated by at least 12 inches of compacted aggregate fill. At a minimum, the bedding and fill material used in the construction of the temporary access culvert crossings shall conform with the aggregate requirements cited in part "i" under "Temporary Culvert Crossing."

TEMP. VEHICULAR STREAM CROSS.

f. When the crossing has served its purpose, all structures including culverts, bedding and filter cloth materials shall be removed. Removal of the structure and clean-up of the area shall be accomplished without construction equipment working in the waterway channel.

g. Upon removal of the structure, the stream shall immediately be shaped to its original cross-section and properly stabilized.

Maintenance

Both structures shall be inspected after every rainfall and at least once a week, whether it has rained or not, and all damages repaired immediately.

TEMP. VEHICULAR STREAM CROSS.

STD & SPEC 3.25
UTILITY STREAM CROSSING

USC

Practice Description

A strategy for crossing small waterways when in-stream utility construction is involved; utilized to help protect sediment from entering the stream from construction within approach areas and to minimize the amount of disturbance within the stream itself.

Conditions Where Practice Applies

Practice generally applicable to flowing streams with drainage areas less than one square mile. Structures or methodology for crossing streams with larger drainage areas should be designed by methods that more accurately define the actual hydrologic and hydraulic parameters that will affect the functioning of the structure.

Construction Specifications

1. Diversion Channel Crossing - Preferred method if construction will remain in area of stream for an extended period (longer than 72 hours) and site conditions (such as width of stream) make diversion practical.

    a. The diversion channel crossing must be operational before work is done in the stream (construction will be performed "in the dry").

    b. Minimum width of bottom shall be six feet or equal to bottom width of existing streambed, whichever is less. Refer to Plates 3.25-1 and 3.25-2.

    c. Maximum steepness of side slopes shall be 2:1. Depth and grade may be variable, dependent on site conditions, but shall be sufficient to ensure continuous flow of water in the diversion.

    d. There are three types of diversion channel linings that can be used, based upon expected velocity of bankfull flow. Refer to Plate 3.25-2 and the following table:

TABLE 3.25-A
DIVERSION CHANNEL LININGS

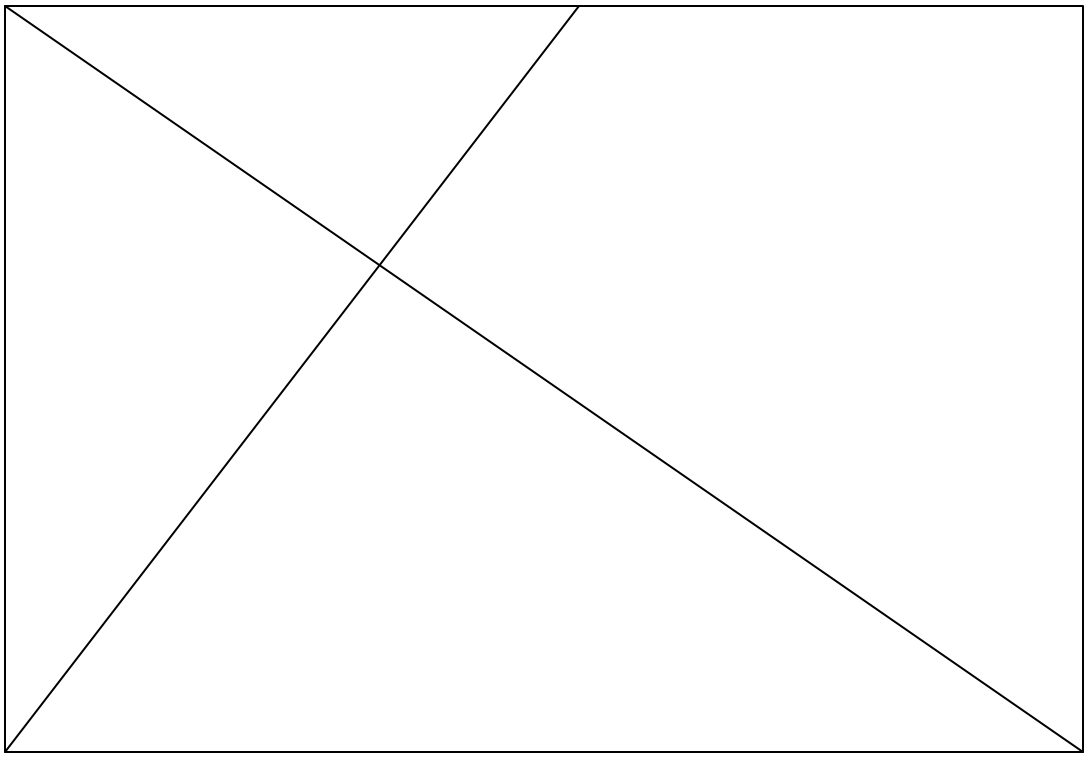
Lining Material	Classifications	Acceptable Velocity Range
Filter Cloth*, Polyethylene or Grass	TYPE A	0 - 2.5 f.p.s
Filter Cloth*	TYPE B	2.5 - 9.0 f.p.s.
Class I Riprap and Filter Cloth*	TYPE C	9.0 - 13.0 f.p.s.

* Filter Cloth must meet the minimum physical requirements noted in Std. & spec. 3.19, RIPRAP.

Source: VDOT Standard Sheets

UTILITY STREAM CROSSING

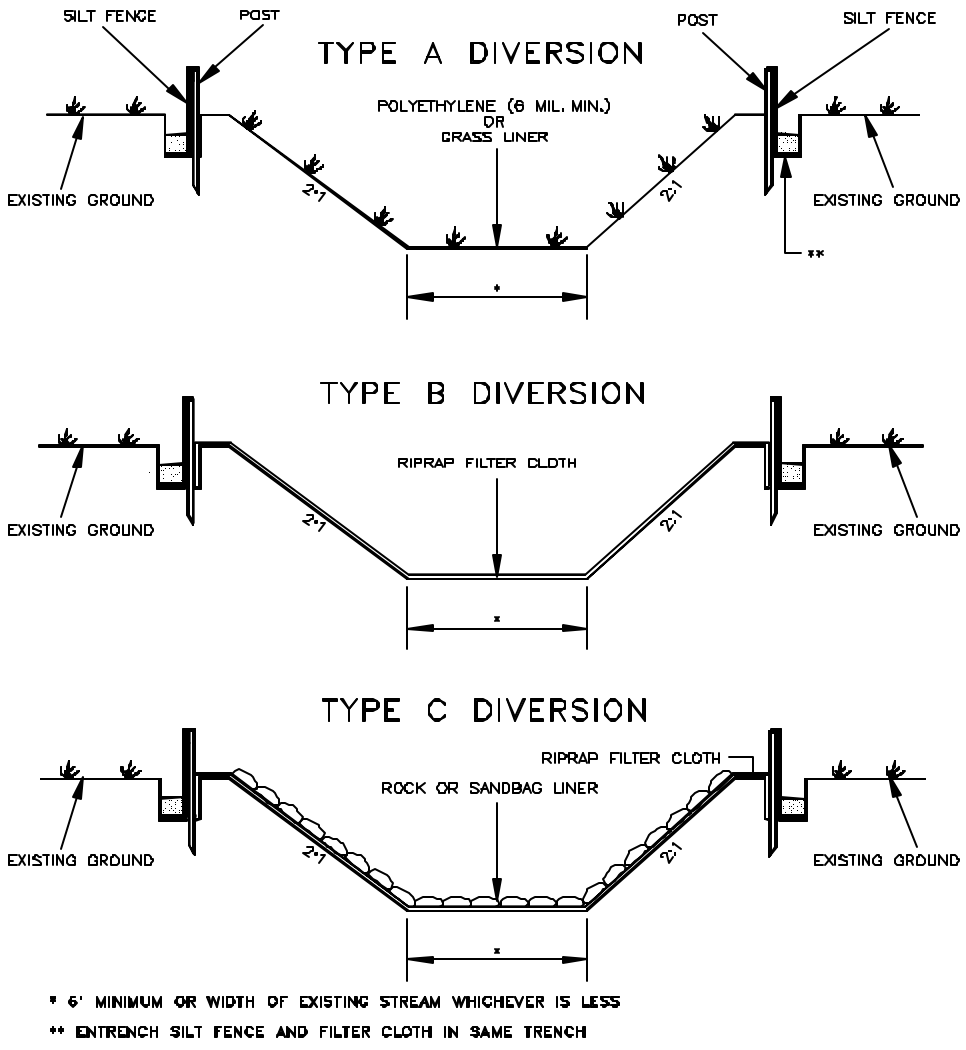
Plate 3.25-1 not available.



UTILITY STREAM CROSSING

DIVERSION CHANNEL CROSSING

ACCEPTABLE LININGS
(CROSS SECTION A–A OF PLATE 3.25–1)



* 6' MINIMUM OR WIDTH OF EXISTING STREAM WHICHEVER IS LESS

** ENTRENCH SILT FENCE AND FILTER CLOTH IN SAME TRENCH

SOURCE: ADAPTED FROM VDOT STANDARDS PLATE. 3.25–2

e. Type A stream diversions may be seeded with a standard seed mix for the type of soils encountered and the time of year seed is sown. An average growth of two inches in height shall be achieved throughout the diversion with an 85% cover before water is turned through it.

f. Stream diversion liners shall be secured at the upstream and downstream sides with non-erodible weights such as riprap. These weights shall allow normal flow of the stream. Soil shall not be mixed in with stream diversion weights. Weights may also be needed along the stream diversion's length to secure liner.

g. Stream diversion liners should be overlapped when single or continuous liner is not available or is impractical. Overlaps should be such that continuous flow of the steam is maintained. An upstream section should overlap a downstream section by a minimum of 18 inches. Overlaps along the cross-section should be made such that a liner is placed in the steam diversion bottom first and additional pieces of liner on the slopes overlap the bottom piece by a minimum of 18 inches.

h. Stream diversion liners shall be entrenched at the top of the diversion slopes (slopes breaks) along with a line of silt fence. Silt fence may be excluded if the diversion liner is extended to such a point that siltation of the stream will not occur. If silt fence is excluded, the diversion liner must be secured. Liners shall extend from slope break to slope break as shown in Plate 3.25-2.

i. Staples used in securing SOIL STABILIZATION BLANKETS AND MATTING (see Std. & Spec. 3.36) or non-erodible weights (riprap) shall be used as necessary to anchor stream diversion liners to the side slopes of the diversion. Wooden stakes should not be used on the diversion's bottom or side slopes.

j. Non-erodible materials such as riprap, jersey barriers, sandbags, plywood, or sheet piling, shall be used as flow barriers to divert the stream away from its original channel and to prevent or reduce water backup into a construction area.

UTILITY STREAM CROSSING

k. The downstream flow barrier is to be removed prior to the upstream barrier when opening a stream diversion for the transport of water.

l. Streams should be rediverted upon completion of the utility crossing for which the diversion was built. Prior to rediversion, any materials (flow barrier) used to prevent water backup into the downstream end of the original streambed shall be removed. This material should not be placed in the downstream end of the diversion until after water has been rediverted to the original waterway. The stream should then be rediverted by removing all of the materials damming the upstream end of the original streambed and then placing it in the upstream end of the stream diversion. The diversion should be sealed off at the downstream end and then backfilled. Once started, any work to relocate a stream shall not be discontinued until it is completed.

m. Stream should be rediverted only after backfilling and restabilization of original streambed and banks is completed. Restabilization shall consist of the installation of ungrouted riprap on all disturbed streambank areas (or on the area 6 feet on both sides of the centerline of its utility trench, whichever is greater) with slopes of 3:1 or greater. Refer to Std. & Spec. 3.19, RIPRAP, for installation requirements. For slopes of 3:1 or less, vegetative stabilization may be used, pending approval by the Plan-Approving Authority or inspection authority.

   Stabilization of its streambed and banks and the approach areas should occur immediately following the attainment of final grade.

n. Any dewatering discharge from this operation shall be placed into an approved DEWATERING STRUCTURE (see Std. & Spec. 3.26).

2. Flume Pipe Crossing - To be used when in-stream construction will last less than 72 hours and stream is narrow (less than 10 feet wide), making "cofferdam" construction impractical.

   a. The flume pipe crossing must be made operational prior to the start of construction in the stream.

b. The materials used (culvert(s), stone and filter fabric) must meet the physical constraints of those used in VEHICULAR STREAM CROSSING, Std. & Spec. 3.24.

c. A large flume pipe (or culvert) of an adequate size to support normal water channel flow (see Table 3.24-A) shall then be installed in the stream bed across the proposed pipeline trench centerline. VDOT #1 Coarse Aggregate (minimum size) or riprap shall be placed close to each end of the flume pipe so as to dam off the creek forcing the water to flow through the flume pipe (see Plate 3.25-3).

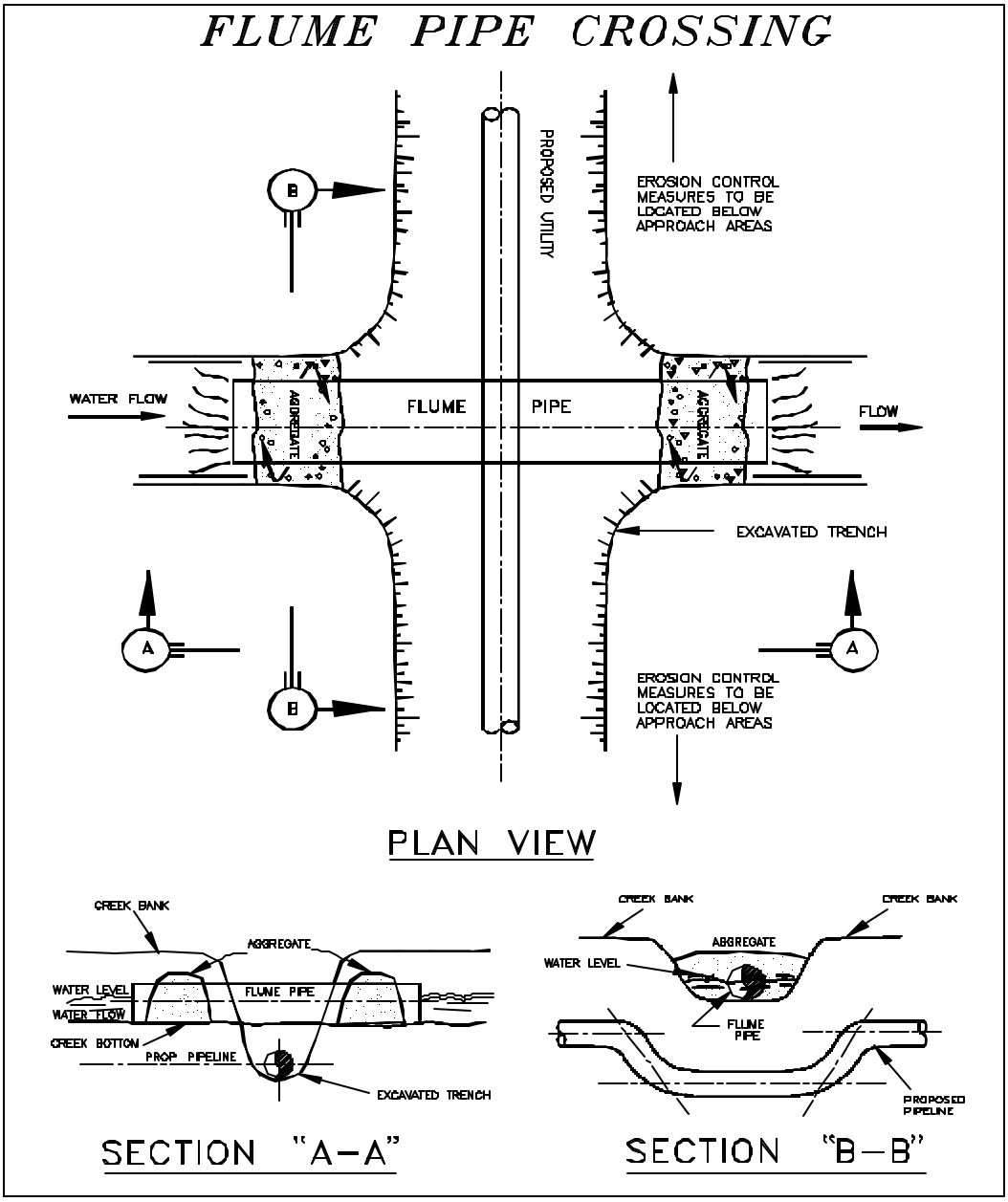
d. The entrapped water can then be pumped from the creek within the dammed-off area and in the proposed trench centerline into an approved DEWATERING STRUCTURE (see Std. & Spec. 3.26). The trench can then be dug under the flume pipe. The pipe sections will then be installed to the proper depth under the flume pipe. After pipe sections are installed, the ditch will be backfilled and restabilization shall be carried out.

e. Restabilization shall consist of the installation of ungrouted riprap on all disturbed streambank areas (or on the area 6 feet on both sides of the centerline of the utility trench, whichever is greater) with slopes of 3:1 or greater. Refer to Std. & Spec. 3.19, RIPRAP, for installation requirements.

   For slopes of 3:1 or less, vegetative stabilization may be used, pending approval by the Plan-Approving Authority or inspection authority. Stabilization of its streambed and banks and the approach areas should occur immediately following the attainment of final grade.

f. After completion of backfilling operation and restoration of stream/creek banks and leveling of stream bed, the flume pipe can then be removed. The gravel can be removed or spread in the stream bed depending on permit requirements.

UTILITY STREAM CROSSING



SOURCE: ADAPTED FROM FORD, BACON, & DAVIS, INC. PLATE. 3.25-3

UTILITY STREAM CROSSING

Sediment controls in approach areas shall not be removed until all construction is completed in stream/creek crossing area. All ground contours shall be returned to their original condition.

3. Cofferdam Utility Crossing - To be used when stream diversion is not practical and stream is wide enough (10 feet or wider) to make cofferdam installation practical.

   a. Construction is to be performed in low flow periods.

   b. Crossing shall be accomplished in a manner that will not prohibit the flow of the stream. (see Plate 3.25-4).

   c. As with all utility line crossings, approach areas must be controlled with perimeter measures such as silt fence or straw bales.

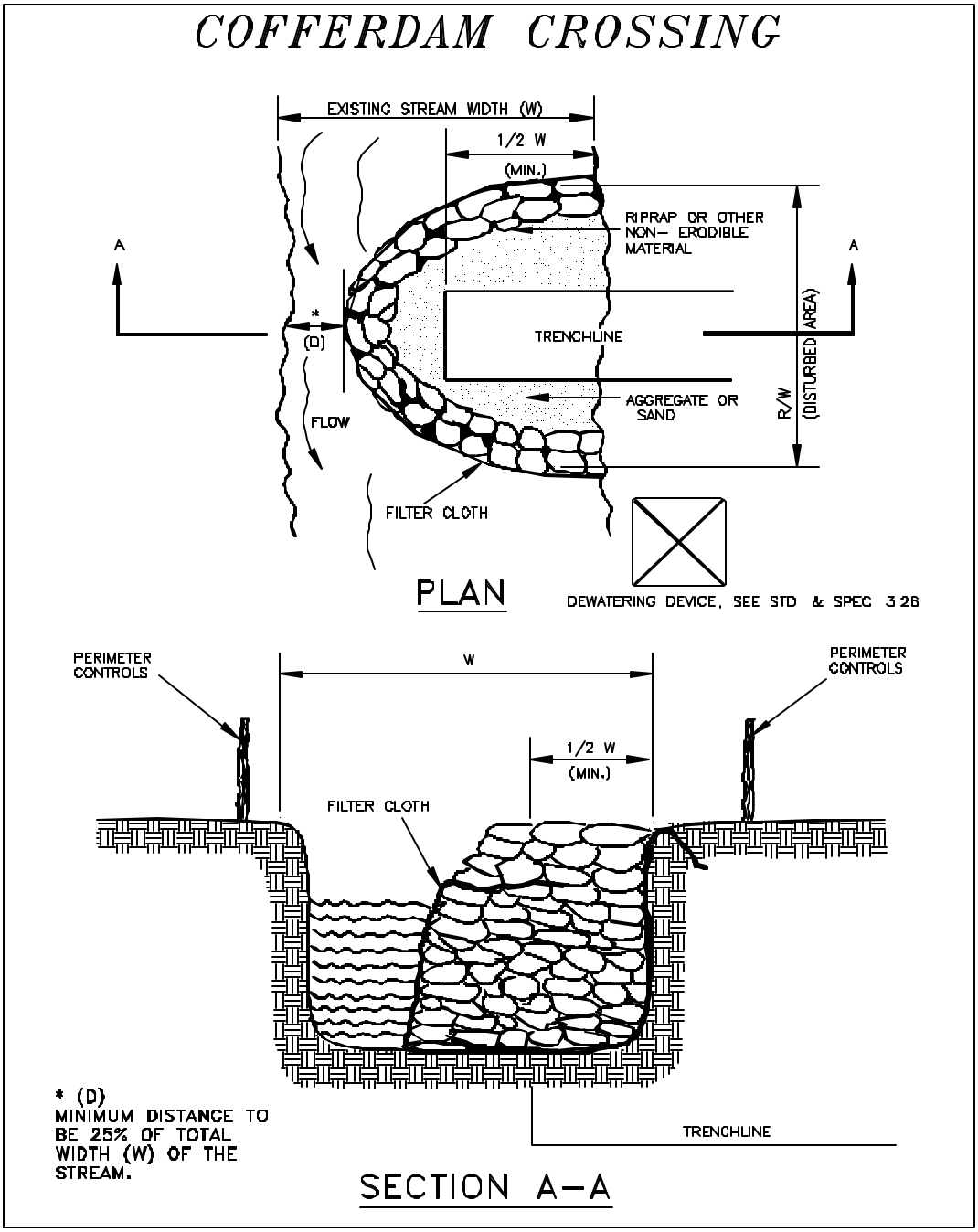
   d. Remove large rocks, woody vegetation, or other material from the streambed and banks that may get in the way of placing the riprap, sandbags, sheet metal, or wood planks or installing the utility pipe or line.

   e. Form a cofferdam by placing the riprap (or other non-erodible materials) in a semicircle along the side of the stream in which the utility installation will begin. It must be surrounded and underlain with filter cloth as shown in Plate 3.25-4. The height of and area within the dam will depend upon the size of the work area and the amount of steam flow. Stack materials as high as will be necessary to keep water from overtopping the dam and flooding the work area. When the stream flow is successfully diverted by the cofferdam, dewater the work area and stabilize it with aggregate (VDOT #57 or #68 Coarse Aggregate) or sand. Make sure to discharge the water into a sediment trapping device (see DEWATERING STRUCTURE, Std. & Spec. 3.26).

   f. Install the utility pipe or line in half the streambed as noted in Plate 3.25-4. Remove the riprap or other materials and begin placing them on the other side of the stream.

UTILITY STREAM CROSSING

COFFERDAM CROSSING



SOURCE: FORD, BACON, & DAVIS, INC. PLATE. 3.25–4

UTILITY STREAM CROSSING

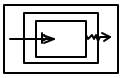
h. Restabilization shall consist of the installation of ungrouted riprap on all disturbed streambank areas (or on the area 6 feet on both sides of the centerline of its utility trench, whichever is greater) with slopes of 3:1 or greater. Refer to Std. & Spec. 3.19, RIPRAP, for installation requirements. For slopes of 3:1 or less, vegetative stabilization may be used, pending approval by Plan-Approving Authority or inspection authority. Stabilization of its streambed and banks and the approach areas should occur immediately following the attainment of final grade.

Maintenance

Care must be taken to inspect any stream crossing area at the end of each day to make sure that the construction materials are positioned securely. This will ensure that the work area stays dry and that no construction materials float downstream.

UTILITY STREAM CROSSING

STD & SPEC 3.26
DEWATERING STRUCTURE



DS

Practice Description

A temporary settling and filtering device for water which is discharged from dewatering activities, used to filter sediment-laden water prior to the water being discharged off-site.

Conditions Where Practice Applies

Wherever sediment-laden water must be removed from a construction site by means of pumping.

Construction Specifications

1. Portable Sediment Tank (see Plate 3.26-1)

   a. The structure may be constructed with steel drums, sturdy wood or other material suitable for handling the pressure exerted by the volume of water.

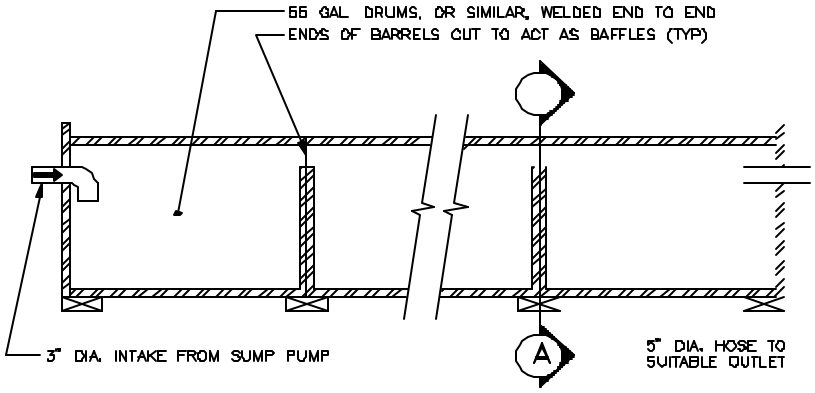
   b. Sediment tanks will have a minimum depth of two feet.

   c. The sediment tank shall be located for easy clean-out and disposal of the trapped sediment and to minimize the interference with construction activities.

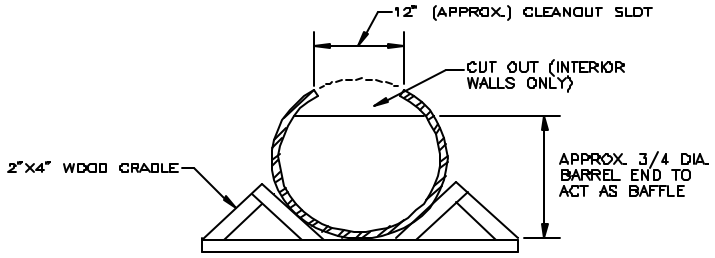
   d. The following formula shall be used to determine storage volume of the sediment tank:

   Pump discharge (g.p.m.) x 16 = cubic feet of storage required.

PORTABLE SEDIMENT TANK



ELEVATION



CROSS–SECTION A–A

SOURCE: USDA – SCS PLATE: 3.26–1

DEWATERING STRUCTURE

e. Once the water level nears the top of the tank, the pump must be shut off while the tank drains and additional capacity is made available.

f. The tank shall be designed to allow for emergency flow over top of the tank.

g. Clean-out of the tank is required once one-third of the original capacity is depleted due to sediment accumulation. The tank shall be clearly marked showing the clean-out point.

2. Filter Box (see Plate 3.26-2)

a. The box selected should be made of steel, sturdy wood or other materials suitable to handle the pressure requirements imposed by the volume of water. Fifty-five gallon drums welded top to bottom are normally readily available and, in most cases, will suffice.

b. Bottom of the box shall be made porous by drilling holes (or some other method).

c. VDOT #3 Coarse Aggregate shall be placed over the holes at a minimum depth of 12 inches (metal "hardware" cloth may need to be placed between the aggregate and the holes if holes are drilled larger than the majority of the stone).

d. As a result of the fast rate of flow of sediment-laden water through the aggregate, the effluent must be directed over a well-vegetated strip of at least 50 feet after leaving the base of the filter box.

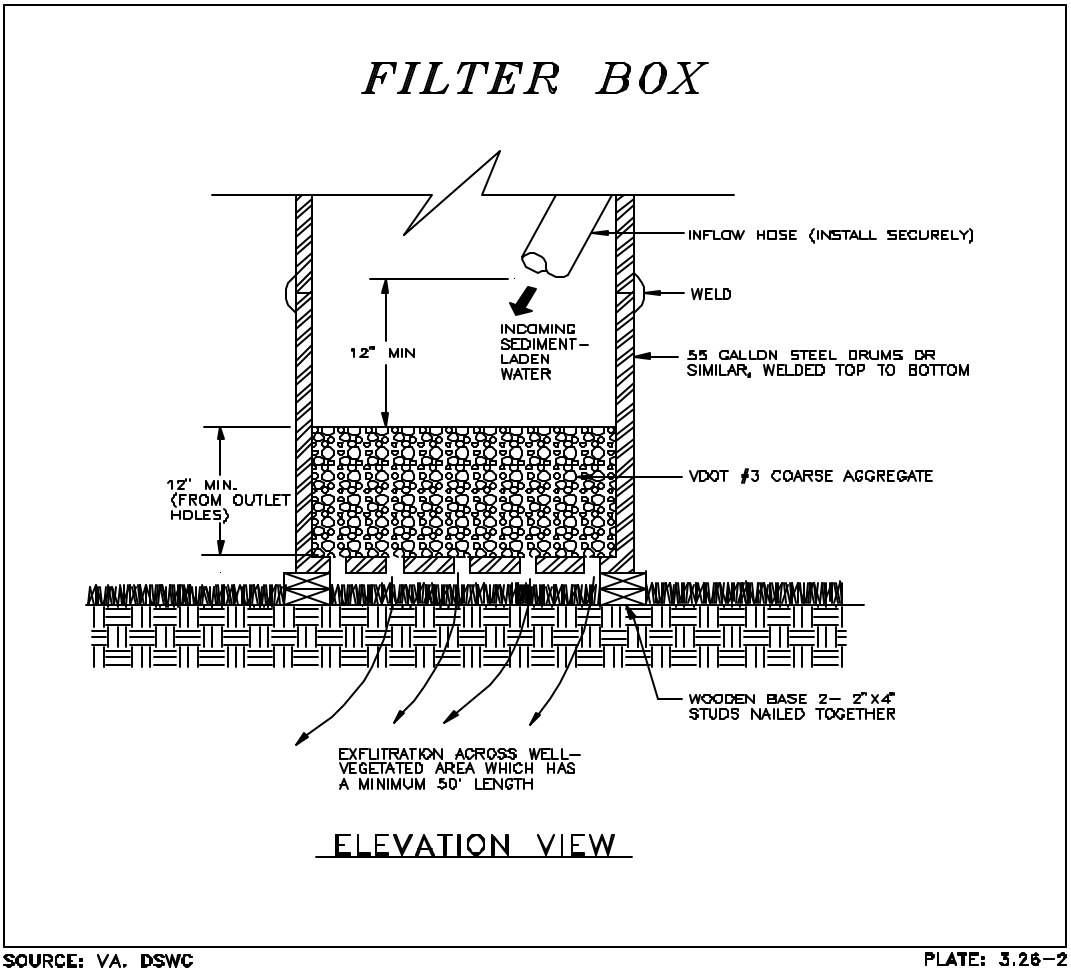
e. The box shall be sized as follows:

Pump discharge (g.p.m.) x 16 = cubic feet of storage required.

f. Once the water level nears the top of the box, the pump must be shut off while the box drains and additional capacity is made available.

g. The box shall be designed/constructed to allow for emergency flow over the top of this box.

DEWATERING STRUCTURE



SOURCE: VA. DSWC PLATE: 3.26-2

h. Clean-out of the box is required once one-third of the original capacity is depleted due to sediment accumulation. The tank shall be clearly marked showing the clean-out point.

i. If the stone filter does become clogged with sediment so that it no longer adequately performs its function, the stones must be pulled away from the inlet, cleaned and replaced.

DEWATERING STRUCTURE

Note: Using a filter box only allows for minimal settling time for sediment particles; therefore, it should only be used when site conditions restrict the use of the other methods.

3. Straw Bale/Silt Fence Pit (see Plate 3.26-3)

   a. Measure shall consist of straw bales, silt fence, a stone outlet (a combination of VDOT Class AI Riprap and VDOT #25 or #26 Aggregate) and a wet storage pit oriented as shown in Plate 3.26-3.

   b. The structure must have a capacity that is dictated by the following formula:

      Pump discharge (g.p.m.) x 16 = cubic feet of storage required.

      In calculating the capacity, one should include the volume available from the floor of the excavation to the crest of the stone weir.

   c. In any case, the excavated area should be a minimum of 3 feet below the base of the perimeter measures (straw bales or silt fence).

   d. The perimeter measures must be installed as per the guidelines found in Std. & Spec. 3.04, STRAW BALE BARRIER and Std. & Spec. 3.05, SILT FENCE.

   e. Once the water level nears the crest of the stone weir (emergency overflow), the pump must be shut off while the structure drains down to the elevation of the wet storage.

   f. The wet storage pit may be dewatered only after a minimum of 6 hours of sediment settling time. This effluent should be pumped across a well-vegetated area or through a silt fence prior to entering a watercourse.

DEWATERING STRUCTURE

g. Once the wet storage area becomes filled to one-half of the excavated depth, accumulated sediment shall be removed and properly disposed of.

h. Once the device has been removed, ground contours will be returned to original condition.

Maintenance

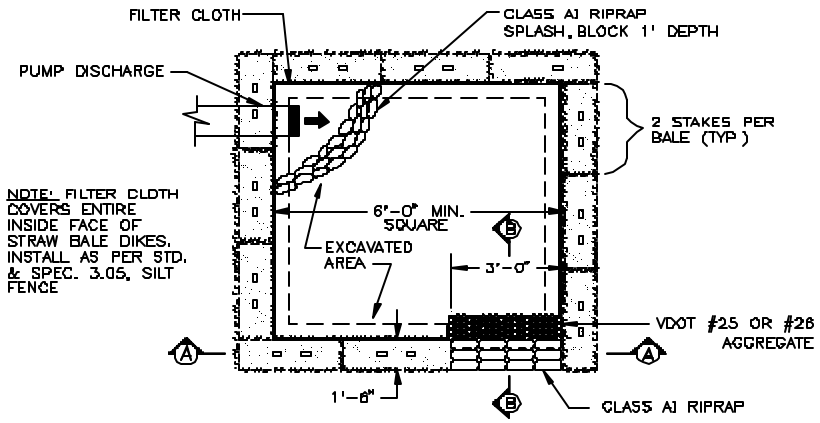
(All dewatering structures)

1. The filtering devices must be inspected frequently and repaired or replaced once the sediment build-up prevents the structure from functioning as designed.

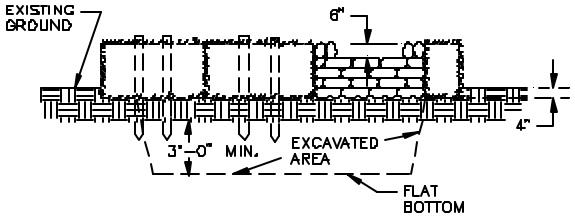
2. The accumulated sediment that is removed from a dewatering device must be spread on-site and stabilized or disposed of at an approved disposal site as per approved plan.

DEWATERING STRUCTURE

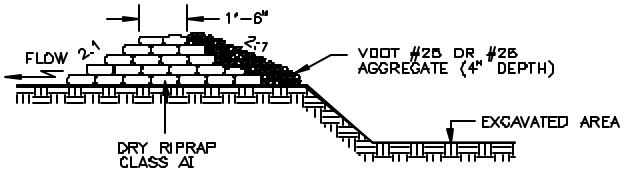
STRAW BALE/SILT FENCE PIT



PLAN VIEW



CROSS-SECTION A-A

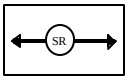


CROSS-SECTION B-B

SOURCE: Va. DSWC PLATE: 3.26-3

DEWATERING STRUCTURE

STD & SPEC 2.29
SURFACE ROUGHENING



SR

Practice Description

Providing a rough soil surface with horizontal depressions created by operating a tillage or other suitable implement on the contour, or by leaving slopes in a roughened condition by not fine-grading them, to aid in establishment of vegetative cover with seed, reduce runoff velocity and increase infiltration, and to reduce erosion and provide for sediment trapping.

Conditions Where Practice Applies

1. All slopes steeper than 3:1 require surface roughening, either stair-step grading, grooving, furrowing, or tracking if they are to be stabilized with vegetation.

2. Areas with grades less steep than 3:1 should have the soil surface lightly roughened and loose to a depth of 2 to 4 inches prior to seeding.

3. Areas which have been graded and will not be stabilized immediately may be roughened to reduce runoff velocity until seeding takes place.

4. Slopes with a stable rock face do not require roughening or stabilization.

Specifications

Cut Slope Applications For Areas Which Will Not Be Mowed

Cut slopes with a gradient steeper than 3:1 shall be stair-step graded or grooved (Plates 3.29-1 and 3.29-2).

1. Stair-step grading may be carried out on any material soft enough to be ripped with a bulldozer. Slopes consisting of soft rock with some subsoil are particularly suited to stair-step grading.

   The ratio of the vertical cut distance to the horizontal distance shall be less than 1:1 and the horizontal portion of the "step" shall slope toward the vertical wall.

Individual vertical cuts shall not be more than 30 inches on soft soil materials and not more than 40 inches in rocky materials.

2. Grooving consists of using machinery to create a series of ridges and depressions which run perpendicular to the slope (on the contour).

   Grooves may be made with any appropriate implement which can be safely operated on the slope and which will not cause undue compaction. Suggested implements include discs, tillers, spring harrows, and the teeth on a front-end loader bucket. Such grooves shall not be less than 3 inches deep nor further than 15 inches apart.

Fill Slope Applications For Areas Which Will Not Be Mowed

Fill slopes with a gradient steeper than 3:1 shall be grooved or allowed to remain rough as they are constructed. Method (1) or (2) below may be used.

1. Groove according to #2 above.

2. As lifts of the fill are constructed, soil and rock materials may be allowed to fall naturally onto the slope surface (see Plate 3.29-3).

   Colluvial materials (soil deposits at the base of slopes or from old stream beds) shall not be used in fills as they flow when saturated.

   At no time shall slopes be bladed or scraped to produce a smooth, hard surface.

Cuts, Fills, and Graded Areas Which Will Be Mowed

Mowed slopes should not be steeper than 3:1. Excessive roughness is undesirable where mowing is planned. These areas may be roughened with shallow grooves such as remain after tilling, discing, harrowing, raking, or use of a cultipacker-seeder. The final pass of any such tillage implement shall be on the contour (perpendicular to the slope).

SURFACE ROUGHENING

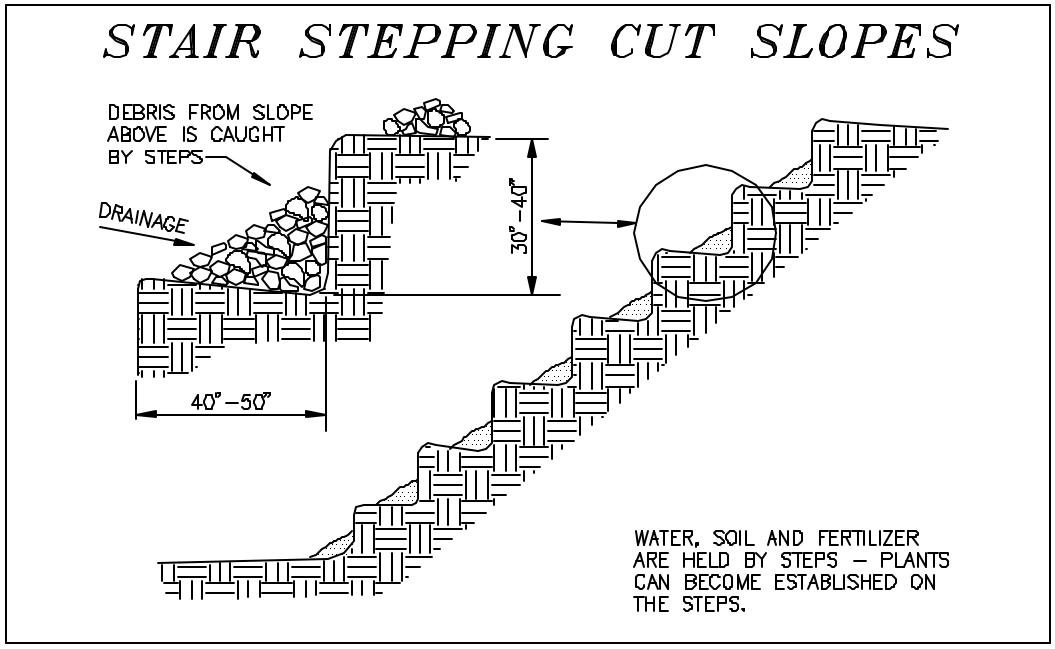
Grooves formed by such implements shall be not less than 1-inch deep and not further than 12-inches apart. Fill slopes that are left rough as constructed may be smoothed with a dragline or pickchain to facilitate mowing.

Roughening With Tracked Machinery (see Plate 3.29-4)
Roughening with tracked machinery on clayey soils is not recommended unless no alternatives are available. Undue compaction of surface soil results from this practice. Sandy soils do not compact severely, and may be tracked. In no case is tracking as effective as the other roughening methods described.

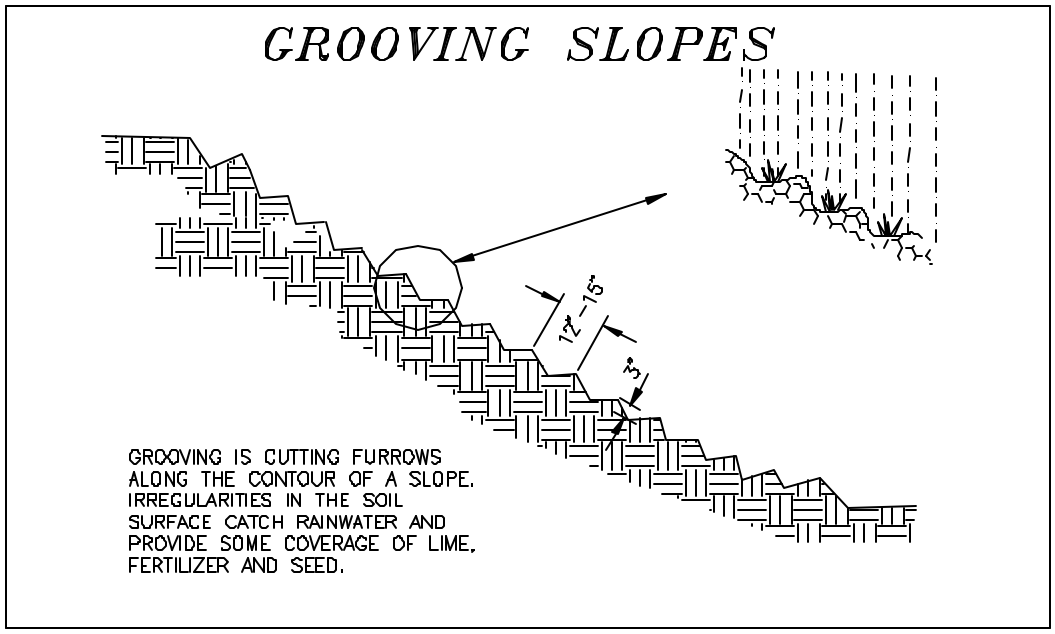
When tracking is the chosen surface roughening technique, it shall be done by operating tracked machinery up and down the slope to leave horizontal depressions in the soil. As few passes of the machinery should be made as possible to minimize compaction.

Seeding
Roughened areas shall be seeded and mulched as soon as possible to obtain optimum seed germination and seedling growth.

SURFACE ROUGHENING

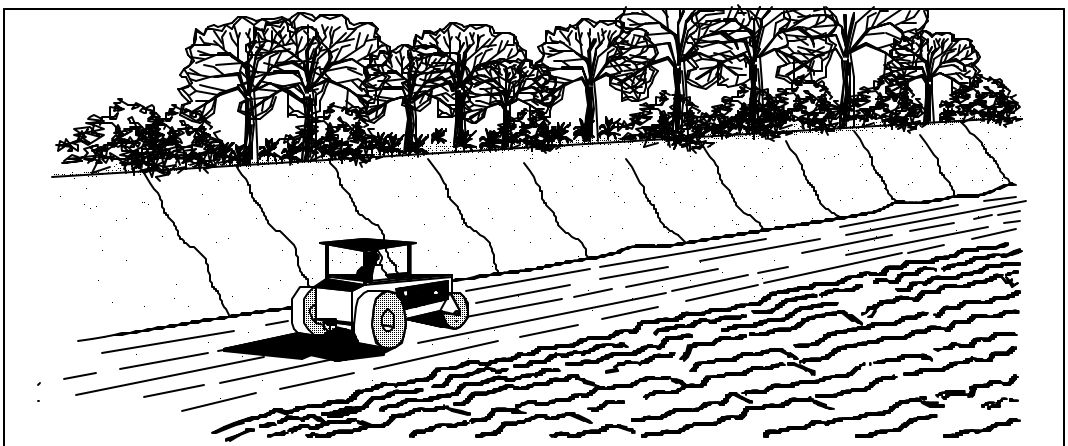


SOURCE. VA. DSWC PLATE 3.29-1



SOURCE: VA. DSWC PLATE 3.29-2

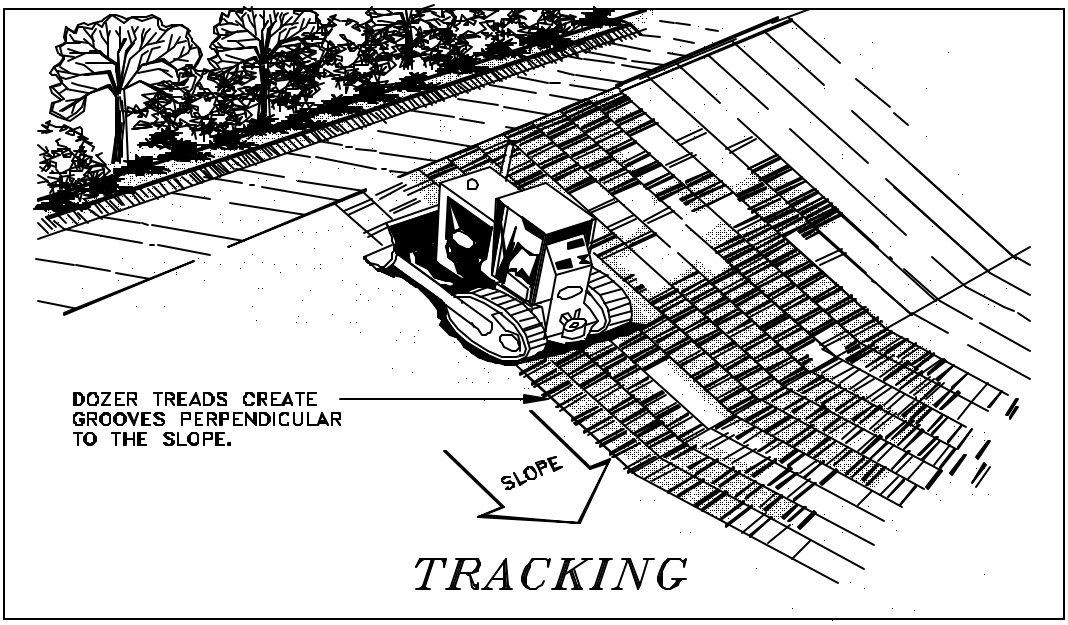
SURFACE ROUGHENING



EACH LIFT OF THE FILL IS COMPACTED, BUT THE OUTER FACE OF THE SLOPE IS ALLOWED TO REMAIN LOOSE SO THAT THE ROCKS, CLODS, ETC. REACH THE NATURAL ANGLE OF REPOSE.

FILL SLOPE TREATMENT

SOURCE: VA. DSWC PLATE. 3.29–3

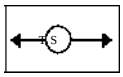


TRACKING

SOURCE: MICHIGAN SOIL EROSION AND SEDIMENTATION CONTROL GUIDEBOOK PLATE. 3.29–4

SURFACE ROUGHENING

STD & SPEC 3.31
TEMPORARY SEEDING



TS

Practice Description

The establishment of a temporary vegetative cover on disturbed areas by seeding with appropriate rapidly growing annual plants; employed to reduce erosion and sedimentation by stabilizing disturbed areas that will not be brought to final grade for a period of more than 14 days, to reduce damage from sediment and runoff to downstream or off-site areas, and to provide protection to bare soils exposed during construction until permanent vegetation or other erosion control measures can be established.

Conditions Where Practice Applies

Where exposed soil surfaces are not to be fine-graded for periods longer than 30 days. Such areas include denuded areas, soil stockpiles, dikes, dams, sides of sediment basins, temporary roadbanks, etc. (see MS #1 and MS #2). A permanent vegetative cover shall be applied to areas that will be left dormant for a period of more than 1 year.

Specifications

Prior to seeding, install necessary erosion control practices such as dikes, waterways, and basins.

Plant Selection

Select plants that are appropriate to the season and site conditions. An extensive description of some of the plants that are commonly utilized for temporary seeding can be found in Appendix 3.31-a.

Seedbed Preparation: To control erosion on bare soil surfaces, plants must be able to germinate and grow. Seedbed preparation is essential.

1. Liming: An evaluation should be conducted to determine if lime is necessary for temporary seeding. In most soils, it takes up to 6 months for a pH adjustment to occur following the application of lime. Therefore, it may be difficult to justify the cost of liming a temporary site, especially when the soil will later be moved and regraded. The following table may be used to determine the actual need along with suggested application rates.

TABLE 3.31-A
LIMING REQUIREMENTS FOR TEMPORARY SITES

pH Test	Recommended Application of Agricultural Limestone
below 4.2	3 tons per acre
4.2 to 5.2	2 tons per acre
5.2 to 6	1 ton per acre

Source: Va. DSWC

2. Fertilizer: Shall be applied as 600 lbs./acre of 10-20-10 (14 lbs./1,000 sq. ft.) or equivalent nutrients. Lime and fertilizer shall be incorporated into the top 2 to 4 inches of the soil if possible.

3. Surface Roughening: If the area has been recently loosened or disturbed, no further roughening is required. When the area is compacted, crusted, or hardened, the soil surface shall be loosened by discing, raking, harrowing, or other acceptable means (see SURFACE ROUGHENING, Std. & Spec. 3.29).

4. Tracking: Tracking with bulldozer cleats is most effective on sandy soils. This practice often causes undue compaction of the soil surface, especially in clayey soils, and does not aid plant growth as effectively as other methods of surface roughening

Seeding: Seed shall be evenly applied with a broadcast seeder, drill, cultipacker seeder or hydroseeder. Small grains shall be planted no more than 1½ inches deep. Small seeds, such as Kentucky Bluegrass, should be planted no more than 1/4 inch deep. Other Grasses and Legumes should be planted from 1/4 inch to 1/2 inch deep.

Mulching:

1. Seedings made in fall for winter cover and during hot and dry summer months shall be mulched according to MULCHING, Std. & Spec. 3.35, except that hydromulches (fiber mulch) will not be considered adequate. Straw mulch should be used during these periods.

2. Temporary seedings made under favorable soil and site conditions during optimum spring and fall seeding dates may not require mulch.

Re-seeding: Areas which fail to establish vegetative cover adequate to prevent rill erosion will be re-seeded as soon as such areas are identified.

TEMPORARY SEEDING

TABLE 3.31-B
ACCEPTABLE TEMPORARY SEEDING PLANT MATERIALS
"QUICK REFERENCE FOR ALL REGIONS"

Planting Dates	Species	Rate (lbs/acre)
Sept. 1 - Feb. 15	50/50 Mix of Annual Ryegrass (Lolium multi-florum) & Cereal (Winter) Rye (Secale cereale)	50 - 100
Feb. 16 - Apr. 30	Annual Ryegrass (Lolium multi-florum)	60 - 100
May 1 - Aug. 31	German Millet (Setaria italica)	50

Source: Va. DSWC

APPENDIX 3.31 - a
PLANT INFORMATION SHEETS

1. **Oats** (Avenasativa): A cool season annual grass primarily grown for animal feed and human consumption, but also used for soil stabilization. Oats are seeded in early spring in the western part of the state (winter oats may be sown in the Coastal Plain). Seeding rates are 3 bushels (100 lbs.) per acre bare ground or 2-1/2 lbs. per 1000 square feet.

2. **Rye** (Secale cereale): Often referred to as Winter Rye because of its winter hardiness, Rye is the most common small grain used for soil stabilization. It is also the most productive grain on dry, infertile, acid or sandy soils. It may be seeded in the fall for winter ground cover. By maturing early, it offers less competition during the late spring period, a critical time in the establishment of perennial species. Rye grain germinates quickly and is tolerant of poor soils.

   Including Rye grain in fall-seeded mixtures is almost always advantageous, but it is particularly helpful on difficult and erodible soils, erodible slopes or when seeding is late. Rates up to 100 lbs. per acre for bare ground. Overly thick stands of Rye grain will suppress the growth of perennial seedlings. Approximately 50 lbs. per acre is the maximum for this purpose and, where lush growth is expected, that rate should either be cut in half or totally eliminated from the mixture.

3. **Foxtail Millet** (Setaria italica): A warm season annual grass which may be used for temporary cover. German Millet (variety commonly used in Virginia) germinates quickly and goes to seed quickly. These features make it an excellent companion grass for summer seedings. It dies at first frost. Seeding rates are up to 50 lbs. per acre for temporary cover. Use 10 to 20 lbs. per acre in mixes.

4. **Annual Rye** (Lolium multiflorum): A cool season annual grass used for temporary cover or as a nurse grass to allow for germination of permanent stands. Most commonly used in mixes for erosion control. Performs well throughout the state in neutral to slightly acid soils. Rates up to 100 lbs. per acre for temporary cover. Use 10 to 20 lbs. per acre in mixes.

5. **Annual Lespedezas** (Lespedeza striata)

Uses: Pasture, hay, erosion control, soil improvement, wildlife food.

Description: Annual warm season legumes. Korean Lespedeza is larger and coarser than Common Lespedeza and grows to about 12 inches. Seed of Korean is shiny and black, while seed of Common is stippled. Kobe is the most desirable variety of Common Lespedeza.

Adaptation: Throughout Virginia. Optimum pH range is 6.0 to 6.5; will grow from 5.5 to 7.0. Will grow in soil textures ranging from sands to clays and though a wide range of fertility conditions.

Establishment: Seed should always be inoculated. May be seeded alone or mixed with grasses or small grains. Requires a firm seedbed; may be broadcast or drilled. Should be seeded in early spring at 25 to 40 lbs. per acre or one-half to 1 lb. per 1000 square feet, depending on use. (Use lower figure as half the seeding rate of any spring seeding with grass or grain). Should not be mowed at less than three inches. Lespedeza will not make a large contribution in sod grasses like Bluegrass; they do best in open sod grasses like tall fescue.

Sources: Seed of common variety (Kobe) and Korean varieties (Climax, Harbin and Rowan) are commercially available.

6. **Weeping Lovegrass** (Eragrostis curvula)

Uses: Fast-growing cover for erosion control. In the northeast, weeping lovegrass acts as a summer annual. The normal life of 3 to 5 years may be foreshortened by low winter temperatures. May provide permanent cover on southern exposure.

Description: A rapid-growing, warm season bunch grass introduced from East Africa. The long, narrow leaves are numerous, very fine, and droop over to the ground, hence the name. Leaf height is rarely above 12 inches.

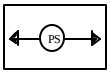
Adaptation: Prefers light-textured, well-drained soil; will thrive on soil of low fertility. Low winter temperatures may deplete stand.

Establishment: Easy to establish by seed; germinates rapidly and grows quickly. Lime and fertilizer needs are similar to those of Tall Fescue and Ryegrass. Requires pH of 5.5 or higher. May be planted any time after danger of frost and throughout the summer. Very fine seed, commonly added to erosion control seed mixtures. Use of hydroseeders is successful if the seeding rate is increased to compensate for the lack of a firm seedbed. Normal seeding rates are 5 to 20 lbs. per acre in mixes.

Sources: Readily available from large seed companies.

TEMPORARY SEEDING

STD & SPEC 3.32
PERMANENT SEEDING



PS

Practice Description

The establishment of perennial vegetative cover on disturbed areas by planting seed. It is utilized for the following:

1. To reduce erosion and decrease sediment yield from disturbed areas.

2. To permanently stabilize disturbed areas in a manner that is economical, adaptable to site conditions, and allows selection of the most appropriate plant materials.

3. To improve wildlife habitat.

4. To enhance natural beauty.

Conditions Where Practice Applies

1. Disturbed areas where permanent, long-lived vegetative cover is needed to stabilize the soil.

2. Rough-graded areas which will not be brought to final grade for a year or more.

Specifications

Selection of Plant Materials

1. Selection of plant materials is based on climate, topography, soils, land use, and planting season.

2. An extensive description of some of the plants which are commonly utilized for permanent seeding can sbe found in Appendix 3.32-c. Plate 3.32-1 shows plant hardiness zones for grasses and legumes for Virginia's two major climate regions:

3. Appropriate seeding mixtures for various site conditions in Virginia are given in Tables 3.32-A, 3.32-B and 3.32-C. These mixtures are designed for general use, and are known to perform well on the sites described.

4. When using some varieties of turfgrasses, the Virginia Crop Improvement Association (VCIA) recommended turfgrass mixtures may also be used. Consumer protection programs have been devised to identify quality seed of the varieties recommended by the Virginia Cooperative Extension Service. These will bear a label indicating that they are approved by the Association. Mixtures may be designed for a specific physiographic region or based on intended use. Special consideration is given to plant characteristics, performance, etc.

TABLE 3.32-A
SITE SPECIFIC SEEDING MIXTURES
FOR APPALACHIAN/MOUNTAIN AREA

Minimum Care Lawn	Total Lbs. Per Acre
- Commercial or Residential	200-250 lbs.
- Kentucky 31 or Turf-Type Tall Fescue	90-100%
- Improved Perennial Ryegrass	0-10%
- Kentucky Bluegrass	0-10%
High-Maintenance Lawn	
Minimum of three (3) up to five (5) varieties of bluegrass from approved list for use in Virginia.	125 lbs.
General Slope (3:1 or less)	
- Kentucky 31 Fescue	128 lbs.
- Red Top Grass	2 lbs.
- Seasonal Nurse Crop **	20 lbs.
	150 lbs.
Low-Maintenance Slope (Steeper than 3:1)	
- Kentucky 31 Fescue	108 lbs.
- Red Top Grass	2 lbs.
- Seasonal Nurse Crop **	20 lbs.
- Crownvetch ***	20 lbs.
	150 lbs.

*Perennial Ryegrass will germinate faster and at lower soil temperatures than fescue, thereby providing cover and erosion resistance for seedbed.

** Use seasonal nurse crop in accordance with seeding dates as stated below:

March, April through May 15th.....Annual Rye
May 16th through August 15th.....Foxtail Millet
August 16th through September, October.....Annual Rye
November through February..... Winter Rye

***If Flatpea is used, increase to 30 lbs./acre. All legume seed must be properly inoculated. Weeping Lovegrass may also be included in any slope or low- maintenance mixture during warmer seeding periods; add 10-20 lbs./acre in mixes.

PERMANENT SEEDING

TABLE 3.32-B
SITE SPECIFIC SEEDING MIXTURES FOR
PIEDMONT AREA

	Total lbs Per Acre
Minimum Care Lawn.	
- Commercial or Residential	175-200 lbs.
- Kentucky 31 or Turf-Type Tall Fescue	95-100%
- Improved Perennial Ryegrass	0-5%
- Kentucky Bluegrass	0-5%
High-Maintenance Lawn	200-250 lbs.
Kentucky 31 or Turf-Type Tall Fescue	100%
General Slope (3:1 or less)	
- Kentucky 31 Fescue	128 lbs.
- Red Top Grass	2 lbs.
- Seasonal Nurse Crop *	20 lbs.
	150 lbs.
Low-Maintenance Slope (Steeper than 3:1)	
- Kentucky 31 Fescue	108 lbs.
- Red Top Grass	2 lbs.
- Seasonal Nurse Crop *	20 lbs.
- Crownvetch **	20 lbs.
	150 lbs.

*Use seasonal nurse crop in accordance with seeding dates as stated below:

February 16th through April..... Annual Rye
May 1st through August 15th..... Foxtail Millet
August 16th through October..... Annual Rye
November through February 15th..... Winter Rye

**Substitute Sericea lespedeza for Crownvetch east of Farmville, Va. (May through September use hulled Sericea, all other periods, use unhulled Sericea). If Flatpea is used in lieu of Crownvetch, increase rate to 30 lbs./acre. All legume seed must be properly inoculated. Weeping Lovegrass may be added to any slope or low-maintenance mix during warmer seeding periods; add 10-20 lbs./acre in mixes.

TABLE 3.32-C
SITE SPECIFIC SEEDING MIXTURES
FOR COASTAL PLAIN AREA

Minimum Care Lawn	Total Lbs Per Acre
- Commercial or Residential	
- Kentucky 31 or Turf-Type Tall Fescue	175-200 lbs.
or	
- Common Bermudagrass **	75 lbs.
High-Maintenance Lawn	
- Kentucky 31 or Turf-Type Tall Fescue	200-250 lbs.
or	
- Hybrid Bermudagrass (seed) **	40 lbs. (unhulled)
or	30 lbs. (hulled)
- Hybrid Bermudagrass (by other vegetative establishment method, see Std. & Spec. 3.34)	
General Slope (3:1 or less)	
- Kentucky 31 Fescue	128 lbs.
- Red Top Grass	2 lbs.
- Seasonal Nurse Crop *	20 lbs.
	150 lbs.
Low Maintenance Slope (Steeper than 3:1)	
- Kentucky 31 Tall Fescue	93-108 lbs.
- Common Bermudagrass **	0-15 lbs.
- Red Top Grass	2 lbs.
- Seasonal Nurse Crop *	20 lbs.
- Sericea Lespedeza **	20 lbs.
	150 lbs.

* Use seasonal nurse crop in accordance with seeding dates as stated below:

February, March through April.....Annual Rye
May 1st through August.....Foxtail Millet
September, October through November 15th.....Annual Rye
November 16th through January.....Winter Rye

** May through October, use hulled seed. All other seeding periods, use unhulled seed. Weeping Lovegrass may be added to any slope or low-maintenance mix during warmer seeding periods; add 10-20 lbs./acre in mixes.

Seedbed Requirements: Vegetation should not be established on slopes that are unsuitable due to inappropriate soil texture, poor internal structure or internal drainage, volume of overland flow, or excessive steepness, until measures have been taken to correct these problems.

To maintain a good stand of vegetation, the soil must meet certain minimum requirements as a growth medium. The existing soil must have these characteristics:

1. Enough fine-grained material to maintain adequate moisture and nutrient supply.

2. Sufficient pore space to permit root penetration. A bulk density of 1.2 to 1.5 indicates that sufficient pore space is present. A fine granular or crumb-like structure is also favorable.

3. Sufficient depth of soil to provide an adequate root zone. The depth to rock or impermeable layers such as hardpans shall be 12 inches or more, except on slopes steeper than 2:1 where the addition of soil is not feasible.

4. A favorable pH range for plant growth. If the soil is so acidic that a pH range of 6.0-7.0 cannot be attained by addition of pH-modifying materials, then the soil is considered an unsuitable environment for plant roots and further soil modification would be required.

5. Freedom from toxic amounts of materials harmful to plant growth.

6. Freedom from excessive quantities of roots, branches, large stones, large clods of earth, or trash of any kind. Clods and stones may be left on slopes steeper than 3:1 if they do not significantly impede good seed soil contact.

If any of the above criteria cannot be met, i.e., if the existing soil is too coarse, dense, shallow, acidic, or contaminated to foster vegetation, then topsoil shall be applied in accordance with TOPSOILING, Std. & Spec. 3.30.

Necessary structural erosion and sediment control practices will be installed prior to seeding. Grading will be carried out according to the approved plan.
Surfaces will be roughened in accordance with SURFACE ROUGHENING, Std. & Spec. 3.29.

Soil Conditioners
In order to modify the texture, structure, or drainage characteristics of a soil, the following materials may be added to the soil:

1. Peat: is a very costly conditioner, but works well. If added, it shall be sphagnum moss peat, hypnum moss peat, reed-sedge peat or peat humus, from fresh-water sources. Peat shall be shredded and conditioned in storage piles for at least six months after excavation.

2. Sand: shall be clean and free of toxic materials. Sand modification is ineffective unless you are adding 80 to 90% sand on a volume basis. This is extremely difficult to do on-site. If this practice is considered, consult a professional authority to ensure that it is done properly.

3. Vermiculite: shall be horticultural grade and free of toxic substances. It is an impractical modifier for larger acreage due to expense.

4. Raw manure: is more commonly used in agricultural applications. However, when stored properly and allowed to compost, it will stabilize nitrogen and other nutrients. Manure, in its composted form, is a viable soil conditioner; however, its use should be based on site-specific recommendations offered by a professional in this field.

5. Thoroughly rotted sawdust shall have 6 pounds of nitrogen added to each cubic yard and shall be free of stones, sticks, and toxic substances.

6. The use of treated sewage sludge has benefited from continuing advancements in its applications in the agricultural community. When composted, it offers an alternative soil amendment. Limitations include a potentially undesirable pH (because of lime added during the treatment process) and the possible presence of heavy metals. This practice should be thoroughly evaluated by a professional and be used in accordance with any local, state, and federal regulations.

Lime and Fertilizer: Lime and fertilizer needs should be determined by soil tests. Soil tests may be performed by the Cooperative Extension Service Soil Testing Laboratory at VPI & SU, or by a reputable commercial laboratory. Information concerning the State Soil Testing Laboratory is available from county extension agents.

Under unusual conditions where it is not possible to obtain a soil test, the following soil amendments will be applied:

Lime:
Coastal Plain: 2 tons/acre pulverized agricultural grade limestone (90 lbs./1000 $ft.^2$).

Piedmont and Appalachian Region: 2 tons/acre pulverized agricultural grade limestone (90 lbs./1000 $ft.^2$).

Note: An agricultural grade of limestone should always be used.

Fertilizer:
Mixed grasses and legumes: 1000 lbs./acre 10-20-10 or equivalent nutrients (23 lbs./1000 $ft.^2$).

Legume stands only:1000 lbs./acre 5-20-10 (23 lbs./1000 $ft.^2$) is preferred; however, 1000 lbs./acre of 10-20-10 or equivalent may be used.

Grass stands only: 1000 lbs./acre 10-20-10 or equivalent nutrients, (23 lbs./1000 $ft.^2$). Other fertilizer formulations, including slow-release sources of nitrogen (preferred from a water quality standpoint), may be used provided they can supply the same amounts and proportions of plant nutrients.

Incorporation: Lime and fertilizer shall be incorporated into the top 4-6 inches of the soil by discing or other means whenever possible. For erosion control, when applying lime and fertilizer with a hydroseeder, apply to a rough, loose surface.

PERMANENT SEEDING

Seeding:

1. Certified seed: will be used for all permanent seeding whenever possible. Certified seed is inspected by the Virginia Crop Improvement Association or the certifying agency in other states. The seed must meet published state standards and bear an official "Certified Seed" label (see Appendix 3.32-a).

2. Legume seed: should be inoculated with the inoculant appropriate to the species. Seed of the Lespedezas, the Clovers and Crownvetch should be scarified to promote uniform germination.

3. Apply seed: uniformly with a broadcast seeder, drill, culti-packer seeder, or hydroseeder on a firm, friable seedbed. Seeding depth should be 1/4 to 1/2 inch.

4. To avoid poor germination rates as a result of seed damage during hydroseeding, it is recommended that if a machinery breakdown of 30 minutes to 2 hours occurs, 50% more seed be added to the tank, based on the proportion of the slurry remaining in the tank. Beyond 2 hours, a full rate of new seed may be necessary.

Often hydroseeding contractors prefer not to apply lime in their rigs as it is abrasive. In inaccessible areas, lime may have to be applied separately in pelletized or liquid form. Surface roughening is particularly important when hydroseeding, as a roughened slope will provide some natural coverage of lime, fertilizer and seed.

Legume inoculants: should be applied at five times the recommended rate when inoculant is included in the hydroseeder slurry.

Mulching: All permanent seeding must be mulched immediately upon completion of seed application. Refer to MULCHING, Std. & Spec. 3.35.

Maintenance of New Seedings

In general, a stand of vegetation cannot be determined to be fully established until it has been maintained for one full year after planting.

Irrigation: New seedings should be supplied with adequate moisture. Supply water as needed, especially late in the season, in abnormally hot or dry weather, or on adverse sites. Water application rates should be controlled to prevent excessive runoff. Inadequate amounts of water may be more harmful than no water.

Re-seeding: Inspect seeded areas for failure and make necessary repairs and re-seedings within the same season, if possible.

a. If vegetative cover is inadequate to prevent rill erosion, over-seed and fertilize in accordance with soil test results.

b. If a stand has less than 40% cover, re-evaluate choice of plant materials and quantities of lime and fertilizer. The soil must be tested to determine if acidity or nutrient imbalances are responsible. Re-establish the stand following seedbed preparation and seeding recommendations.

Fertilization: Cool season grasses should begin to be fertilized 90 days after planting to ensure proper stand and density. Warm season fertilization should begin at 30 days after planting.

Apply maintenance levels of fertilizer as determined by soil test. In the absence of a soil test, fertilization should be as follows:

Cool Season Grasses

4 lbs. nitrogen (N)
1 lb. phosphorus (P)???? / 1000 ft.^{2} per year
2 lbs. potash (K)

Seventy-five percent of the total requirements should be applied between September 1 and December 31st. The balance should be applied during the remainder of the year.

More than 1 lb. of soluble nitrogen per 1000 ft^2 should not be applied at any one time.

Warm Season Grasses:

1. Apply 4-5 lbs. nitrogen (N) between May 1 and August 15th per 1000 $ft.^2$ per year.

2. Phosphorus (P) and Potash (K) should only be applied according to soil test.

Note: The use of slow-release fertilizer formulations for maintenance of turf is encouraged to reduce the number of applications and the impact on groundwater.

Additional Information on the Successful Establishment of Grasses and Legumes

See Appendix 3.32-b for "helpful hints" in achieving high success rates in grass or legume plantings.

APPENDIX 3.32-a
SEED QUALITY CRITERIA

Where certified seed is not available, the minimum requirements for grass and legume seed used in vegetative establishment are as follows:

a. All tags on containers of seed shall be labeled to meet the requirements of the State Seed Law.

b. All seed shall be subject to re-testing by a recognized seed laboratory that employs a registered seed technologist or by a state seed lab.

c. All seed used shall have been tested within twelve (12) months.

d. Inoculant - the inoculant added to legume seed in the seed mixtures shall be a pure culture of nitrogen-fixing bacteria prepared for the species. Inoculants shall not be used later than the date indicated on the container. Twice the supplier's recommended rate of inoculant will be used on dry seedings; five times the recommended rate if hydroseeded.

e. The quality of the seed used shall be shown on the bag tags to conform to the guidelines in Table 3.32-E.

TABLE 3.32-E
QUALITY OF SEED*

Legumes	Minimum Seed Purity(%)	Minimum Germination(%)
Crownvetch	98	65**
Lespedeza, Korean	97	85**
Lespedeza, Sericea	98	85**
Grasses		
Bluegrass, Kentucky	97	85
Fescue, Tall (Improved, Turf-Type Cultivars)	98	85
Fescue, Tall (Ky-31)	97	85
Fescue, Red	98	85
Redtop	94	80
Reed Canarygrass	98	80
Perennial Ryegrass	98	90
Weeping Lovegrass	98	87
Annuals		
Annual Ryegrass	97	90
German Millet	98	85
Oats	98	80
Cereal Rye	98	85

* Seed containing prohibited or restricted noxious weeds should not be accepted. Seed should not contain in excess of 0.5% weed seed. To calculate percent pure, live seed, multiply germination times purity and divide by 100.

Example: Ky-31 Tall Fescue with a germination of 85 percent and a purity of 97 %.
97 x 85 = 8245. 8245 ? 100 = 82.45% pure live seed.

**Includes "hard seed"

APPENDIX 3.32-b
KEYS TO SUCCESSFUL ESTABLISHMENT OF GRASSES AND LEGUMES

Planning: Where feasible, grading operations should be planned around optimal seeding dates for the particular region. The most effective times for establishing perennial grass in Virginia generally extend from March through May and from August through October. Outside these dates, the probability of failure is much higher. If the time of year is not suitable for seeding a permanent cover (perennial species), a temporary cover crop should be planted. Temporary seeding of annual species (small grains, ryegrasses or millets) often succeeds during periods of the year that are unsuitable for seeding permanent (perennial) species. Variations in weather and local site conditions can modify the effects of regional climate on seeding success. For this reason, mixtures including both cool and warm season species are preferred for low-maintenance cover, particularly in the Coastal Plain. Such mixtures promote cover which can adapt to a range of conditions. Many of these mixtures are not desirable, however, for high quality lawns, where variation in texture of the turf is inappropriate. It is important to note that in Virginia the establishment of 100% warm season grasses in a high quality lawn is limited to the extreme eastern portions of the Coastal Plain.

Selection: Species selection should be considered early in the process of preparing an erosion and sediment control plan. A variety of vegetation can be established in Virginia due to the diversity in both soils and climate. However, for practical, economical stabilization and long-term protection of disturbed sites, species selection should be made judiciously. Seasonality must be considered when selecting species. Grasses and legumes are usually classified as warm or cool season in reference to their season of growth.

Cool season plants realize most of their growth during the spring and fall and are relatively inactive or dormant during the hot summer months. Therefore, fall is the most favorable time to plant them. Warm season plants "green-up" late in the spring, grow most actively during the summer, and go dormant at the time of the first frost in fall. Spring and early summer are preferred planting times for warm season plants.

PERMANENT SEEDING

Seed Mixtures: As previously noted, the establishment of high quality turf frequently involves planting one single species. However, in seedings for erosion control purposes, the inclusion of more than one species should always be considered. Mixtures need not be excessive in poundage or seed count. The addition of a quick-growing annual provides early protection and facilitates establishment of one or two perennials in a mix. More complex mixtures might include a quick-growing annual, one or two legumes and more than one perennial grass. The addition of a "nurse" crop (quick-growing annuals added to permanent mixtures) is a sound practice for soil stabilization, particularly on difficult sites - those with steep slopes; poor, rocky, erosive soils; those seeded out the optimum seeding periods; or in any situation where the development of permanent cover is likely to be slow. The nurse crop germinates and grows rapidly, holding the soil until the slower-growing perennial seedlings become established.

APPENDIX 3.32 - c
PLANT INFORMATION SHEETS

1. **Tall Fescue** (Festuca arundinacea)

Uses: Pasture, hay, recreation areas, lawns and stabilization of waterways, banks, slopes, cuts, fills, and spoils. It is the most widely used grass at this time for stabilizing large disturbed areas.

Description: A robust, cool season, long-lived, deep-rooted bunchy grass which may have short rhizomes (underground stems). Kentucky 31 is the best-known variety. A number of new varieties of Tall Fescue are becoming available for lawn and other fine-turf uses, and several offer definite improvements. However, their higher cost over the old standby, KY 31, is seldom justified when used for purposes of stabilization and erosion control. Tall Fescue tolerates a wide range of seeding dates; however, with the possible exception of high mountain elevations, it is most dependable when planted in fall.

Adaptation: Adapts well to both high and low maintenance uses throughout Virginia. Adapted to a wide range of climatic conditions. Optimum pH range is 6.0 to 7.0; will tolerate from 3.0 to 8.0. Will grow on shallow and claypan soils if they are moist. Growth is limited more by moisture than by temperature extremes, but it will tolerate drought, infertile soils and shade.

Establishment: Requires a firm seedbed. Hydroseeding is successful. Seeding Rates vary from 100 lbs. per acre for erosion control to 250 lbs. per acre for lawns. Plant in early spring or from the middle of August through September. Legumes may not thrive in fescue stands due to the aggressive growth habits of this grass. Mowing is desirable on critical areas at least once every two years; lack of periodic mowing will encourage clumpiness.

Sources: Readily available as seed and sod.

2. Kentucky Bluegrass (Poa pratense)

Uses: Pasture, turf for lawns, athletic fields, golf courses, and playgrounds. Also used to stabilize waterways, slopes, cuts and fills. Choice food for grouse, turkeys, deer and rabbits.

Description: Long-lived, cool season perennial grass which forms a dense sod. Becomes dormant in the heat of summer since its growing season is spring and fall.

Adaptation: Best adapted to well - drained, fertile soils of limestone origin and the climate of northern and western Virginia. Optimum pH range is 6.0 to 7.0. Bluegrasses are better suited to high maintenance situations in the transitions zone. Essentially dormant during dry or hot weather; however, it will normally survive severe drought.

Establishment: Requires a firm, weed-free seedbed and adequate fertilization (liberal phosphorus) and lime are important. Can be used with Tall Fescues at low rates. Minimum mowing height is 1-1/2 inches. Critical erosion areas may be mowed only once per year, if desired. This grass is usually seeded with a mixture of other grasses or legumes; several varieties of Bluegrass should be used together to ensure good stand survival. Bare ground rates are 120 lbs. per acre. Overseed 1 to 1-1/2 lbs per 1000 square feet.

Sources: Readily available as seed and sod.

3. **Perennial Ryegrass** (Lolium perrenne)

Uses: Erosion control, soil improvement, lawns, pasture, and hay; newer varieties are excellent for high-traffic areas.

Description: Perennial Ryegrasses are an excellent selection where rapid establishment is desired. Cool season Ryegrasses cross-pollinate freely so "Common Ryegrass" may be a mixture of annual and perennial species. Certified seed of Perennial Ryegrass varieties is produced: Blaser, Palmer, Goalie, Fiesta II, Ranger, Regal and Pennfine may be used in Virginia.

Establishment: A firm, shallow surface over compact subsoil gives good results. Seed in fall or spring. Perennial Ryegrass may also be seeded in Mid-August to early September. For turf, use a rate of 5 to 8 lbs. per 1000 square feet, if seeded alone; lesser amounts are suitable in mixtures, depending on the characteristics of the companion species. Generally not seeded alone except on athletic fields with intensive use. Perennial Ryegrass does best when used with Bluegrass as 20 percent or less of the mixture. Ryegrasses germinate rapidly, which makes them particularly suited to disturbed-area stabilization and temporary seeding. They will, however, tend to dominate stands in mixtures if percentage is too high.

Sources: Readily available commercially. Care should be taken to buy seed appropriate to the needs of the project.

4. **Bermudagrass** (Cynodon dactylion)

Uses: Soil and water conservation, pasture, hay, silage, lawns, both high maintenance and general purpose turf, and stabilization of grassed waterways.

Description: A long-lived, warm season perennial that spreads by stolons and rhizomes (runners and underground stems). Height of stems of Common Bermudagrass may be 12 inches. The stems are short-jointed and the leaves flat and spreading.

Common Bermudagrass may be established vegetatively with sprigs (sections of stems) or from seeds; however, it has the potential to develop into a weed problem because it spreads vigorously. Cold-tolerant hybrids are usually specified. These are traditionally established from sprigs or sod, but seed is now available.

Adaptation: Southern Piedmont and Costal Plain in Virginia and some southern Appalachian ridges and valleys. Check Std. & Spec. 3.34 for regional adaptations of varieties. Makes its best growth when average daily temperatures are above 75 degrees. Grows on a wide range of soils from heavy clays to deeps sands. Optimum pH is 6.0 to 6.5. It is drought-resistant and salt-tolerant. Tolerates floods of short duration but will not thrive on waterlogged soils; does not persist under heavy shade. For rough areas, the varieties Midland (a forage hybrid) and Coastal are recommended. For fine-turf areas, Tufcote (a fine-leaved

turf hybrid), Midiron, Tifway, and Vamont are used in Virginia.

Establishment: By sodding or planting sprigs. Sprigs should be planted (by hand or machine) when soil is warm in a well-prepared, moist seedbed. One end of the sprig should extend above ground, and the other should be covered by firmly packed soil.

Sources: Readily available as seed, sprigs, and sod.

5. **Redtop** (Agrostis alba)

Uses: Erosion control, pasture, companion grass in turf seedings and stabilizing ditch and channel banks, grassed waterways, and other disturbed areas.

Description: A coarse, cool season perennial grass with rhizomes (underground stems). Grows to 30 to 40 inches.

Adaptation: Throughout Virginia; does better in the cool, humid areas. Will grow under a wide variety of soil and moisture conditions. Grows on very acid soils of low fertility. While drought-resistant, it is also a useful wetland grass.

Establishment: Has very small seed and requires a compact seedbed. May be sown in early spring or late summer. Seldom seeded alone except as temporary turf. Adequate fertilization is essential on critical areas to obtain good cover rapidly. Most commonly added to mixes, usually 2 to 3 lbs. per acre. Redtop will disappear from a stand under frequent low mowing.

Sources: Available from commercial sources.

6. **Crownvetch** (Coronilla varia)

Uses: For erosion control of critical areas such as steep roadbanks, surface mine spoils and industrial waste areas. It is also useful as a residential ground cover. It provides high-quality forage for ruminant animals and serves as a wildlife food and cover plant.

Description: A deep-rooted, cool season, perennial, herbaceous legume with a semi-reclining growth habit. It reaches 2 to 3 feet in height, and does not climb or twine. It fixes nitrogen in the soil and makes a dense mat of vegetative cover.

Adaptation: Best adapted to the northern Piedmont and Mountain regions of Virginia. It grows best on well-drained soils with a pH range of 5.5 to 8.3. It will persist on more acid soils for a prolonged period once established. It is not adapted to soils with poor drainage. Crownvetch is winter-hardy and drought tolerant. Varieties commonly used are Chemung, Penngift, and Emerald.

Establishment: Only inoculated seed should be used. Requires at least 500 lbs. per acre of 5-10-10 fertilizer (or the area should be fertilized according to soil test results). Soil acidity must be raised above a pH of 5.5. Crownvetch requires mulch and can be hydroseeded successfully.

Seeding in the spring is most successful. Frost-seeding may be used on steep or stony sites (seed in late winter, and allow frost action to work the seed into soil). Crownvetch often takes 2 to 3 years to establish a dense stand. A companion grass such as Perennial Ryegrass or Redtop needs to be mixed into the initial planting, but the Crownvetch will eventually crowd out the companion plants. It will not persist under frequent mowing.

Sources: Available commercially

7. **Sericea Lespedeza** (Lespedeza cuneata)

Uses: Hay, pasture, erosion control, cover crop, wildlife food.

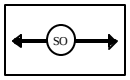
Description: Warm season perennial legume with upright woody stems 12 to 18 inches tall. Roots widely branched penetrating soil 3 feet or more.

Adaptation: Well adapted to all parts of Virginia. Best on well-drained, deep soils of medium texture. Will also grow on sandy, rather acidic, infertile soils. Most often the legume of choice for eastern Virginia. Optimum pH range is 6.0 to 6.5, but will tolerate a range of 5.0 to 7.0. It is drought-tolerant. Common varieties in Virginia are Serala and Interstate.

Establishment: Seed from April to June. Requires a firm seedbed. Use only inoculated seed. Rates vary from 20 to 30 lbs. of unhulled seed per acre. Requires phosphate and potash. Will not persist under frequent mowing (once a year recommended).

Sources: Seed of common varieties is commercially available.

STD & SPEC 3.33
SODDING



Practice Description

Stabilizing fine-graded disturbed areas by establishing permanent grass stands with sod. It is utilized for the following:

1. To establish permanent turf immediately.

2. To prevent erosion and damage from sediment and runoff by stabilizing the soil surface.

3. To reduce the production of dust and mud associated with bare soil surfaces.

4. To stabilize drainageways where concentrated overland flow will occur.

5. For use as a filtering device for sediments in areas prior to achieving permanent stabilization.

Conditions Where Practice Applies

1. Disturbed areas which require immediate vegetative covers, or where sodding is preferred to other means of grass establishment.

2. Locations particularly suited to stabilization with sod are:
   - Waterways carrying intermittent flow
   - Area around drop inlets or in grassed swales
   - Residential or commercial lawns where quick use or aesthetics are factors

Specifications

Soil Preparation

1. Prior to soil preparation, areas to be sodded shall be brought to final grade in accordance with the approved plan.

2. Soil tests should be made to determine the exact requirements for lime and fertilizer. The State Laboratory at VPI & SU or a reputable commercial laboratory may conduct soil tests. Information on state soil tests is available from county or city agricultural extension agents.

   Under difficult circumstances where it is not possible to obtain a soil test, the following soil amendments shall be made:

   Pulverized agricultural limestone at 90 lbs./1000 sq. ft. (2 tons/acre).

   Fertilizer at 25 lbs./1000 sq. ft. (1000 lbs./acre) of 10-10-10 in fall, or 25 lbs./1000 sq. ft. of 5-10-10 in spring.

   Note: Equivalent nutrients may be applied with other fertilizer formulations.

   These amendments shall be spread evenly over the area to be sodded, and incorporated (if possible) into the top 3 to 6 inches of the soil by discing, harrowing or other acceptable means.

3. Prior to laying sod, the soil surface shall be clear of trash, debris, large roots, branches, stones and clods in excess of 1 inch in length or diameter. Sod shall not be applied to gravel or other non-soil surfaces.

4. Any irregularities in the soil surface resulting from top-soiling or other operations shall be filled or leveled in order to prevent the formation of depressions or water pockets.

5. Areas to be topsoiled and topsoil used shall fulfill the requirements of TOPSOILING, Std. & Spec. 3.30. No sod shall be spread on soil which has been treated with soil sterilants or any other toxic herbicides until enough time has elapsed to permit dissipation of toxic materials.

SODDING

Quality of Sod

1. Sod used shall be state-certified. Certified turfgrass sod is grown from Certified seed, inspected and certified by the Virginia Crop Improvement Association (VCIA) or the certifying agency in other states. This ensures genetic purity, high quality, freedom from noxious weeds and excessive insect or disease problems. The sod must meet published state standards and bear an official blue "Certified Turf" label on the bill of lading.

2. High-quality sod is also available outside of the VCIA certified sod program. When purchasing this sod, the consumer is encouraged to be aware of factors which are important in determining sod quality. High-quality sod will contain the best varieties and be free of serious disease, insect, or weed problems. It will be dense, have good color, and hold together well.

3. Sod shall be machine cut at a uniform soil thickness of 3/4 inch (± 1/4 inch) at the time of cutting. This thickness shall exclude shoot growth and thatch.

4. Pieces of sod shall be cut to the supplier's standard width and length, with a maximum allowable deviation in any dimension of 5%. Torn or uneven pads will not be acceptable.

5. Standard size sections of sod shall be strong enough to support their own weight and retain their size and shape when suspended from a firm grasp on one end of the section.

6. Sod shall not be cut or laid in excessively wet or dry weather.

7. Sod shall be harvested, delivered, and installed within a period of 36 hours.

Choosing Appropriate Types of Sod

The type of sod used must be composed of plants adapted to the locality. Use Table 3.33-A to select the type of sod best suited to your area.

Sod Installation (See Plate 3.33-1)

1. Sod should not be laid on soil surfaces that are frozen.

2. During periods of high temperature, the soil shall be lightly irrigated immediately prior to laying the sod, to cool the soil and reduce root burning and dieback.

3. The first row of sod shall be laid in a straight line with subsequent rows placed parallel to and butting tightly against each other. Lateral joints shall be staggered to promote more uniform growth and strength. Care shall be exercised to ensure that sod is not stretched or overlapped and that all joints are butted tight in order to prevent voids which would cause drying of the roots.

4. On slopes 3:1 or greater, or wherever erosion may be a problem, sod shall be laid with staggered joints and secured by stapling or other approved methods. Sod shall be installed with the length perpendicular to the slope (on the contour).

5. As sodding of clearly defined areas is completed, sod shall be rolled or tamped to provide firm contact between roots and soil.

6. After rolling, sod shall be irrigated to a depth sufficient that the underside of the sod pad and the soil 4 inches below the sod are thoroughly wet.

7. Until such time a good root system becomes developed, in the absence of adequate rainfall, watering shall be performed as often as necessary to maintain moist soil to a depth of at least 4 inches.

8. The first mowing shall not be attempted until the sod is firmly rooted, usually 2-3 weeks. Not more than one third of the grass leaf shall be removed at any one cutting.

SODDING

TABLE 3.33-A
TYPE OF SOD AVAILABLE IN VIRGINIA
AND RECOMMENDED USES

Kentucky Bluegrass: Adapted to the Northern Piedmont and Mountain Regions. Individual varieties selected must make up not less than 10%, not more than 35% of the total mixture on a weight basis. All varieties must be certified. Selections can be made from Category I alone or various combinations of Categories I, II and III, as noted.

Category I:	Recommended Kentucky Bluegrass Varieties
65% - 100%	A-34, Abbey, Aspen, Asset, Baron, Blacksburg, Bristol, Cheri, Chateau, Classic, Coventry, Georgetown, Glade, Haga, Julia, Liberty, Loft's 1757, Merit, Midnight, Monopoly, Plush, Princeton 104, Rugby, Suffolk, Victa
Category II:	Special use varieties. If used, must contain at least 65% Category I varieties
Shade Tolerant	
10-35%	Bristol, Columbia, Georgetown, Glade, Midnight
Low-Maintenance Tolerant	
10-35%	Columbia, Georgetown, Monopoly, Ram I, Touchdown, Victa
Category III:	Promising Kentucky Bluegrass - Limited performance data or seed availability
10-35%	Dawn, Estate, Freedom, Kelly

SODDING

TABLE 3.33-A (CONTINUED)
SOD TYPES AVAILABLE
IN VIRGINIA & RECOMMENDED USES

Tall Fescue: Adapted to the entire state.

Recommended Tall Fescue Varieties:

90-100%	Amigo, Apache, Bonanza, Chieftain, Finelawn 5GL, Mesa, Rebel II, Shenandoah, Tribute

Promising Tall Fescues

Certified Arriba, Austin, Avanti, Aztec, Cochise, Crossfire, Eldorado, Hubbard 87, Jaguar II, Maverick II, Monarch, Olympic II, Phoenix, Safari, Shortstop, Sundance, Taurus, Thoroughbred, Titan, Tradition, Vegas, Winchester, Wrangler

0-10%	Kentucky Bluegrass: Baron, Cheri, Columbia, Monopoly, Nassau, Ram I, Victa

Bermuda grass: Tufcote is adapted to the Richmond-Danville-Newport News triangle. Midiron may be used east of Roanoke and south of Charlottesville. Tifgreen and Tifway may be used to the east and south of Richmond. Vamont may be used east of Roanoke and at lower elevations in southwestern Virginia.

Certified Midiron, Tifgreen#, Tifway, Tifway II, Tufcote and Vamont

Zoysiagrass: This sod performs best in southeastern Virginia. Meyer, Emerald#

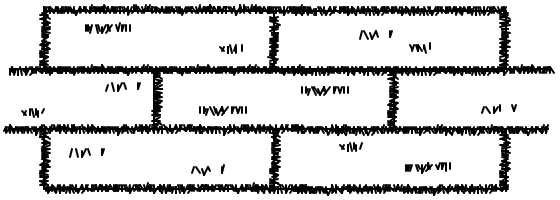
Note: Common Bermudagrass is not recommended for sod production.

Only recommended in southeastern Virginia.

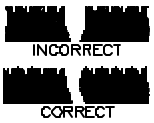
Source: 1991 Virginia Turfgrass Variety Recommendations, Virginia Crop Improvement Association

SODDING

SODDING

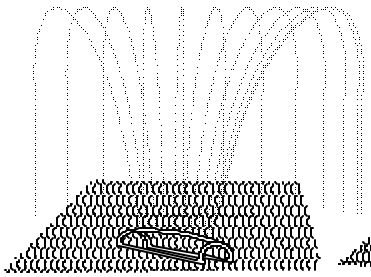


LAY SOD IN A STAGGERED PATTERN BUTT THE STRIPS TIGHTLY AGAINST EACH OTHER. DO NOT LEAVE SPACES AND DO NOT OVERLAP. A SHARPENED MASON'S TROWEL IS A HANDY TOOL FOR TUCKING DOWN THE ENDS AND TRIMMING PIECES.

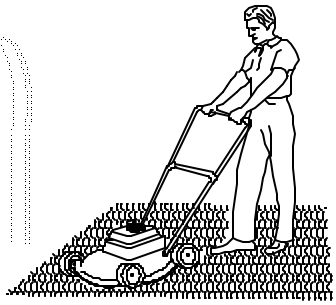


BUTTING – ANGLED ENDS CAUSED BY THE AUTO-MATIC SOD CUTTER MUST BE MATCHED CORRECTLY.

ROLL SOD IMMEDIATELY TO ACHIEVE FIRM CONTACT WITH THE SOIL.

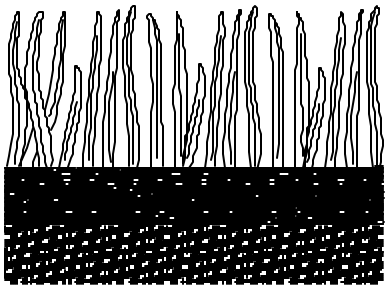


WATER TO A DEPTH OF 4" AS NEEDED. WATER WELL AS SOON AS THE SOD IS LAID.



MOW WHEN THE SOD IS ESTABLISHED – IN 2-3 WEEKS, SET THE MOWER HIGH (2"-3").

APPEARANCE OF GOOD SOD



SHOOTS OR GRASS BLADES GRASS SHOULD BE GREEN AND HEALTHY. MOWED AT A 2"-3" CUTTING HEIGHT.

THATCH – GRASS CLIPPINGS AND DEAD LEAVES, UP TO 1/2" THICK.

ROOT ZONE – SOIL AND ROOTS. SHOULD BE 1/2"-3/4" THICK, WITH DENSE ROOT MAT FOR STRENGTH.

SOURCE: VA. DSWC

PLATE: 3.33-1

SODDING

Sodded Waterways

1. Care should be taken to prepare the soil adequately in accordance with this specification. The sod type shall consist of plant materials able to withstand the designed velocity (see STORMWATER CONVEYANCE CHANNELS, Std. & Spec. 3.17).

2. Sod strips in waterways shall be laid perpendicular to the direction of flow. Care should be taken to butt ends of strips tightly.

3. After rolling or tamping, sod shall be pegged or stapled to resist washout during the establishment period. Jute mesh or other netting may be pegged over the sod for extra protection in critical areas.

4. All other specifications for this practice shall be adhered to when sodding a waterway.

Maintenance of Established Sod

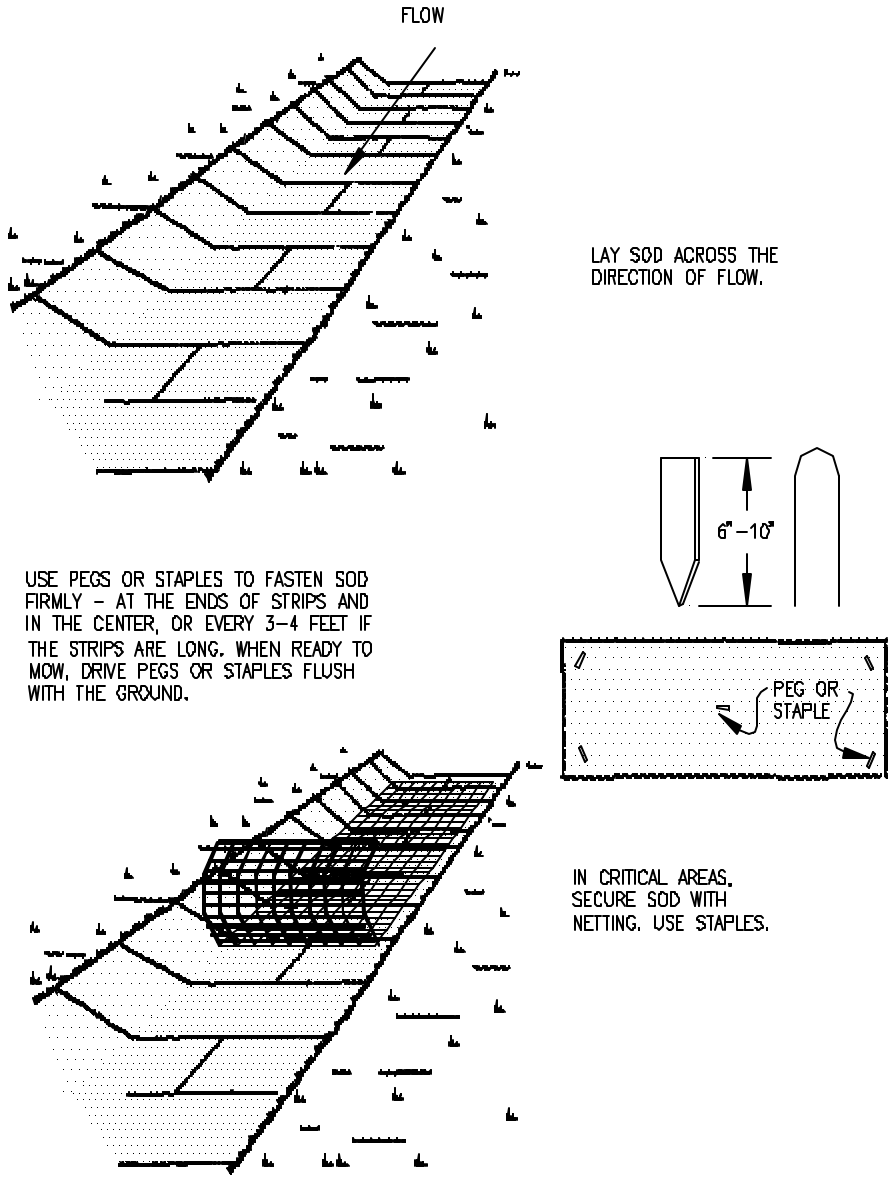
1. During the 2 to 3 week establishment stage, sod shall be watered as necessary to maintain adequate moisture in the root zone and prevent dormancy of sod.

2. No more than one third of the shoot (grass leaf) should be removed in any mowing. Grass height should be maintained between 2 and 3 inches unless otherwise specified.

3. After the first growing season, established sod will require fertilization and may require lime. Follow soil test recommendations when possible, or apply maintenance levels as outlined in Table 3.33-B.

SODDING

SODDED WATERWAYS



SOURCE: VA. DSWC PLATE: 3.33-2

SODDING

TABLE 3.33-B
MAINTENANCE FERTILIZATION
OF ESTABLISHED SOD

Cool Season Grasses
4 lbs. nitrogen (N) per 1000 sq. ft./year
1 lb. phosphorus (P) per 1000 sq. ft./year
2 lbs. Potash (K) per 1000 sq. ft./year

75% of the total requirements should be applied between September 1 and December 31st.The balance should be applied during the remainder of the year.

Warm Season Grasses
Apply 4-5 lbs. nitrogen (N) per 1000 sq. ft. per year (between May 1st and August 15th).

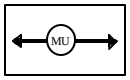
Phosphorus (P) and Potash (K) should only be applied according to soil tests.

Maintenance fertilizations should utilize slow release fertilizers which reduce the number of applications per year and subsequently reduce the adverse impacts on groundwater.

Source: Va. DSWC

SODDING

STD & SPEC 3.35
MULCHING



MU

Practice Description

Application of plant residues or other suitable materials to the soil surface, to prevent erosion by protecting the soil surface from raindrop impact and reducing the velocity of overland flow and to foster the growth of vegetation by increasing available moisture and providing insulation against extreme heat and cold.

Conditions Where Practice Applies

1. Areas which have been permanently seeded (see Std. & Spec. 3.32, PERMANENT SEEDING) should be mulched immediately following seeding.

2. Areas which cannot be seeded because of the season should be mulched to provide some protection to the soil surface. An organic mulch should be used, and the area then seeded as soon weather or seasonal conditions permit. It is not recommended that fiber mulch be used alone for this practice; at normal application rates it just simply does not provide the protection that is achieved using other types of mulch.

3. Mulch may be used together with plantings of trees, shrubs, or certain ground covers which do not provide adequate soil stabilization by themselves.

4. Mulch shall be used in conjunction with temporary seeding operations as specified in TEMPORARY SEEDING, Std. & Spec. 3.31.

Specifications

Organic Mulches

Organic mulches may be used in any area where mulch is required, subject to the restrictions noted in Table 3.35-A.

Materials: Select mulch material based on site requirements, availability of materials, and availability of labor and equipment. Table 3.35-A lists the most commonly used organic mulches. Other materials, such as peanut hulls and cotton burs, may be used with the permission of the local Plan-Approving Authority.
Prior to mulching: Complete the required grading and install needed sediment control practices.

Lime and fertilizer should be incorporated and surface roughening accomplished as needed. Seed should be applied prior to mulching except in the following cases:

a. Where seed is to be applied as part of hydroseeder slurry containing fiber mulch.

b. Where seed is to be applied following a straw mulch spread during winter months.

MULCHING

TABLE 3.35-A
ORGANIC MULCH MATERIALS AND APPLICATION RATES

MULCHES:	RATES:		NOTES:
	Per Acre	Per 1000/SQ. FT.	
Straw or Hay	1 1/2 -2 tons (Min. 2 tons for winter cover)	70-90 lbs.	Free from weeds and coarse matter. Must be anchored. Spread with mulch blower or by hand.
Fiber Mulch	Minimum 1500 lbs.	35 lbs.	Do not use as mulch for winter cover or during hot, dry periods* Apply as slurry.
Corn Stalks	4-6 tons	185-275 lbs.	Cut or Shredded in 4-6" lengths. Air-dried. Do not use in fine turf areas. Apply with mulch blower or by hand.
Wood Chips	4-6 tons	185-275 lbs.	Free of coarse matter. Air-dried. Treat with 12 lbs. nitrogen per ton. Do not use in fine turf areas. Apply with mulch blower or by hand.
Bark Chips or Shredded Bark	50-70 cu. yds.	1-2 cu. yds	Free of coarse matter. Air-dried. Treat with 12 lbs. nitrogen per ton. Do not use in fine turf areas. Apply with mulch blower,chip handler or by hand.

* When fiber mulch is the only available mulch during periods when straw should be used, apply at a minimum rate of 2000 lbs./ac. or 45 lbs./1000 sq. ft.

MULCHING

Application: Mulch materials shall be spread uniformly, by hand or machine.

When spreading straw mulch by hand, divide the area to be mulched into approximately 1,000 sq. ft. sections and place 70-90 lbs. (1½ to 2 bales) of straw in each section to facilitate uniform distribution.

Mulch Anchoring: Straw mulch must be anchored immediately after spreading to prevent displacement. Other organic mulches listed in Table 3.35-A do not require anchoring. The following methods of anchoring straw may be used:

1. Mulch anchoring tool (often referred to as a Krimper or Krimper Tool): This is a tractor-drawn implement designed to punch mulch into the soil surface. This method provides good erosion control with straw. It is limited to use on slopes no steeper than 3:1, where equipment can operate safely. Machinery shall be operated on the contour.

2. Fiber Mulch: A very common practice with widespread use today. Apply fiber mulch by means of a hydroseeder at a rate of 500-750 lbs./acre over top of straw mulch or hay. It has an added benefit of providing additional mulch to the newly seeded area.

3. Liquid mulch binders: Application of liquid mulch binders and tackifiers should be heaviest at edges of areas and at crests of ridges and banks, to prevent displacement. The remainder of the area should have binder applied uniformly. Binders may be applied after mulch is spread or may be sprayed into the mulch as it is being blown onto the soil.

   The following types of binders may be used:

   a. Synthetic binders - Formulated binders or organically formulated products may be used as recommended by the manufacturer to anchor mulch.

MULCHING

*b. Asphalt - Any type of asphalt thin enough to be blown from spray equipment is satisfactory. Recommended for use are rapid curing (RC-70, RC-250, RC-800), medium curing (MC-250, MC-800) and emulsified asphalt (SS-1, CSS-1,CMS-2, MS-2, RS-1, RS-2, CRS-1,and CRS-2). Apply asphalt at 0.10 gallon per square yard (10 gal./1000 sq.ft. or 430 gal./acre). Do not use heavier applications as it may cause the straw to "perch" over rills. All asphalt designations are from the Asphalt Institute Specifications.

* Note: This particular method is not used as commonly today as it once was in the past. The development of hydraulic seeding equipment promoted the industry to turn to synthetic or organically based binders and tackifiers. When this method is used, environmental concerns should be addressed to ensure that petroleum-based products do not enter valuable water supplies. Avoid applications into waterways or channels.

4. Mulch nettings: Lightweight plastic, cotton, or paper nets may be stapled over the mulch according to manufacturer's recommendations.

5. Peg and twine: Because it is labor-intensive, this method is feasible only in small areas where other methods cannot be used. Drive 8- to 10-inch wooden pegs to within 3 inches of the soil surface, every 4 feet in all directions. Stakes may be driven before or after straw is spread. Secure mulch by stretching twine between pegs in a criss-cross-within-a square pattern. Turn twine 2 or more times around each peg.

Chemical Mulches

Chemical mulches* may be used alone only in the following situations:

a. Where no other mulching material is available.

b. In conjunction with temporary seeding during the times when mulch is not required for that practice.

MULCHING

c. From March 15 to May 1 and August 15 to September 30, provided that they are used on areas with slopes no steeper than 4:1, which have been roughened in accordance with SURFACE ROUGHENING, Std. & Spec. 3.29. If rill erosion occurs, another mulch material shall be applied immediately.

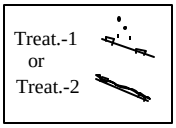
* Note: Chemical mulches may be used to bind other mulches or with fiber mulch in a hydroseeded slurry at any time. Manufacturer's recommendations for application of chemical mulches shall be followed.

Maintenance

All mulches and soil coverings should be inspected periodically (particularly after rainstorms) to check for erosion. Where erosion is observed in mulched areas, additional mulch should be applied. Nets and mats should be inspected after rainstorms for dislocation or failure. If washouts or breakage occur, re-install netting or matting as necessary after repairing damage to the slope or ditch. Inspections should take place up until grasses are firmly established. Where mulch is used in conjunction with ornamental plantings, inspect periodically throughout the year to determine if mulch is maintaining coverage of the soil surface; repair as needed.

MULCHING

SOIL STABILIZATION
BLANKETS & MATTING



B/M

Practice Description

The installation of a protective covering (blanket) or a soil stabilization mat on a prepared planting area of a steep slope, channel or shoreline, to aid in controlling erosion on critical areas by providing a microclimate which protects young vegetation and promotes its establishment. In addition, some types of soil stabilization mats are also used to raise the maximum permissible velocity of turf grass stands in channelized areas by "reinforcing the turf" to resist the forces of erosion during storm events.

Conditions Where Practice Applies

On short, steep slopes where erosion hazard is high and planting is likely to be too slow in providing adequate protective cover; in vegetated channels where the velocity of design flow exceeds "allowable" velocity; on streambanks or tidal shorelines where moving water is likely to wash out new plantings; or in areas where the forces of wind prevent standard mulching practices from remaining in place until vegetation becomes established.

TREATMENT-1: SOIL STABILIZATION BLANKET

(Allowable Velocity Range During Vegetation Establishment: 0-4 f.p.s)

Materials

1. Combination Blankets - They shall consist of a photo degradable plastic netting which covers and is entwined in a natural organic or man-made mulching material.

   The mulching material shall consist of wood fibers, wood excelsior, straw, coconut fiber, or man-made fibers, or a combination of the same.

The blanket shall be of consistent thickness with the mulching material/fibers evenly distributed over its entire length. The mulching material/fibers must interlock or entwine to form a dense layer that not only resists raindrop impact, but will allow vegetation to penetrate the blanket.

The blanket shall be nontoxic to vegetation and to the germination of seed and shall not be injurious to the unprotected skin of humans. At a minimum, the plastic netting must cover the top side of the blanket and possess a high web strength. The netting shall be entwined with the mulching material/fiber to maximize strength and provide for ease of handling.

2. Jute Mesh - It shall be a uniform, open, plain weave, of undyed and unbleached single jute yarn. The yarn shall be a loosely twisted construction and shall not vary in thickness by more than one half of its normal diameter. Jute mesh shall be new and shall conform to the following:

   a. Length of jute mesh shall be marked on each roll.

   b. There shall be 0.60-inch openings (+/- 25%) between strands, lengthwise.

   c. There shall be 0.90-inch openings (+/- 25%) between strands, widthwise.

   d. Weight shall average 0.90 lbs./square yard with a tolerance of 5%.

   As previously noted, jute mesh provides such good coverage (large surface area of strands) and contains such small openings that it can be used alone as a blanket.

3. Other **Teatment-1** Products - These shall conform to manuacturer's specifications and be approved by the Plan-Approving Authority prior to being specified for a particular application. These products should be installed in accordance with manufacturer's recommendations, provided those recommendations are at least as stringent as this specification. Again, it is recommended that VDOT's "Approved Products List" be consulted. In no case shall these products cover less than 30% of the soil surface.

4. Staples - Staples for anchoring Treatment-1 shall be No. 11-gauge wire of heavier. Their length shall be a minimum of 6 inches. A larger staple with a length of up to 12 inches should be used on loose, sandy, or unstable soils.

Installation Requirements

Site Preparation - After site has been shaped and graded to approved design, prepare a friable seedbed relatively free from clods and rocks more than 1½ inches in diameter and any foreign material that will prevent uniform contact of the protective covering with the soil surface.

Planting - Lime, fertilize, and seed in accordance with seeding or other type of planting plan. When using jute mesh on a seeded area, apply approximately one-half the seed after laying the mat. The protective covering can be laid over sprigged areas where small grass plants have been inserted into the soil.

Where ground covers are to be planted, lay the protective covering first and then plant through the material as per planting design.

When open-weave nets are used, lime, fertilizer, seed and mulch should be applied before laying the net. When a combination blanket (such as an "excelsior" blanket) is used, seed and soil amendments must also be applied before the blanket is laid.

Orientation - See Plate 3.36-1 for orientation of **Treatment-1** for different topographic conditions.

Laying and Stapling (see Plate 3.36-2) - If instructions have been followed, all needed check slots will have been installed, and the protective covering will be laid on a friable seedbed free from clods, rocks, roots, etc. that might impede good contact.

1. Start laying the protective covering from the top of the channel or top of slope and unroll down-grade.

2. Allow to lay loosely on soil - do not stretch.

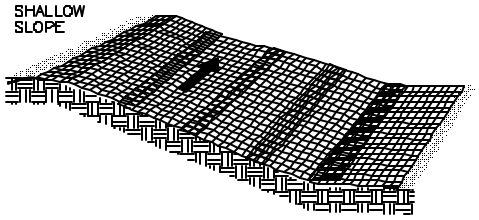
3. Upslope ends of the protective covering should be buried in an anchor slot no less than 6-inches deep. Tamp earth firmly over the material. Staple the material at a minimum of every 12 inches across the top end.

4. Edges of the material shall be stapled every 3 feet. Where multiple widths are laid side by side, the adjacent edges shall be overlapped a minimum of 2 inches and stapled together.

5. Staples shall be placed down the center, staggered with the edges at 3 foot intervals.

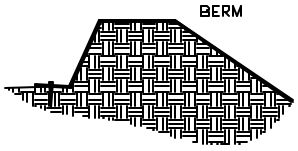
Check slots - On highly erodible soils and on slopes steeper than 4:1, erosion check slots should be made every 50 feet (see Plate 3.36-2). Insert a fold of the material (separate piece) into a 6-inch trench and tamp firmly. Staple fold to "main" blanket at minimum 12-inch intervals across the upstream and downstream portion of the blanket.

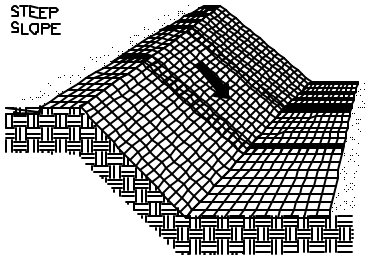
TYPICAL ORIENTATION OF TREATMENT – 1 (SOIL STABILIZATION BLANKET)



ON SHALLOW SLOPES, STRIPS OF NETTING PROTECTIVE COVERINGS MAY BE APPLIED ACROSS THE SLOPE.

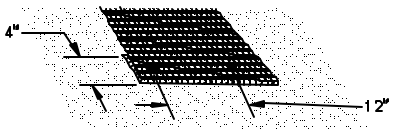
WHERE THERE IS A BERM AT THE TOP OF THE SLOPE, BRING THE MATERIAL OVER THE BERM AND ANCHOR IT BEHIND THE BERM.

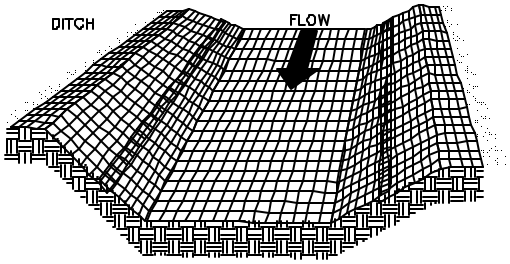




ON STEEP SLOPES, APPLY PROTECTIVE COVERING PARALLEL TO THE DIRECTION OF FLOW AND ANCHOR SECURELY.

BRING MATERIAL DOWN TO A LEVEL AREA BEFORE TERMINATING THE INSTALLATION TURN THE END UNDER 4" AND STAPLE AT 12" INTERVALS.



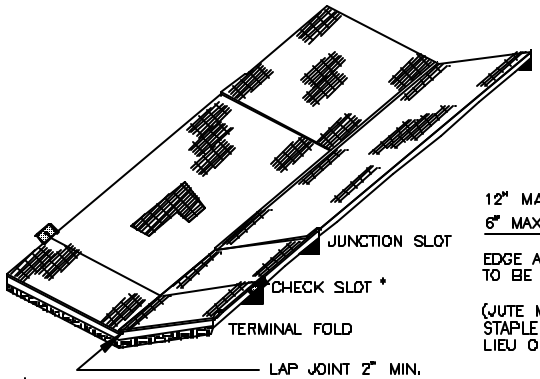


IN DITCHES, APPLY PROTECTIVE COVERING PARALLEL TO THE DIRECTION OF FLOW. USE CHECK SLOTS AS REQUIRED. AVOID JOINING MATERIAL IN THE CENTER OF THE DITCH IF AT ALL POSSIBLE

SOURCE: ADAPTED FROM LUDLOW PRODUCTS BROCHURE PLATE: 3.36-1

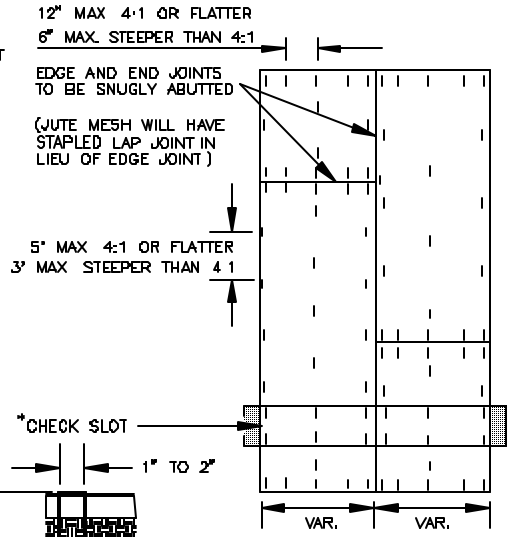
SOIL STABIL. BLANKETS/MATTING

TYPICAL TREATMENT – 1
(SOIL STABILIZATION BLANKET)
INSTALLATION CRITERIA

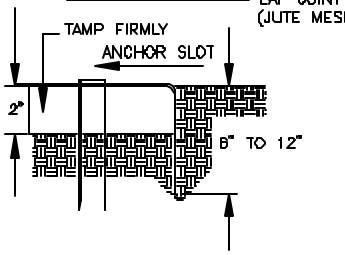


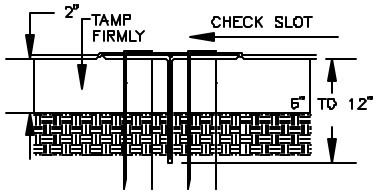
NOTES

APPROXIMATELY 200 STAPLES REQUIRED PER 100 SQ. YDS. OF MATERIAL ROLL. ANCHOR SLOTS, JUNCTION SLOTS & CHECK SLOTS TO BE BURIED 6" TO 12".



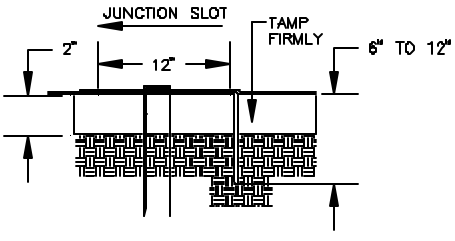
PLAN VIEW
STAPLING DIAGRAM

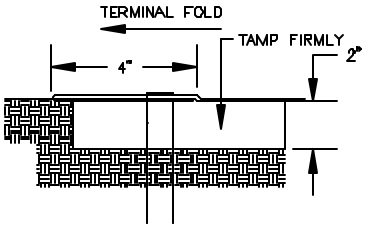




STAPLE FORMED FROM NO.11 STEEL WIRE.
8" STAPLE MIN. LENGTH FOR SANDY SOIL.
6" STAPLE MIN. LENGTH FOR OTHER SOIL

*CHECK SLOTS AT MIN. 50' C–C INTERVALS, NOT REQ.'D WITH ALL "COMBINATION" BLANKETS





SOURCE: VDOT ROAD AND BRIDGE STANDARDS PLATE: 3.36–2

Note: Many combination blankets are designed and manufactured to resist movement and uplift to a point which check slots may not be required. Plan designers and review authorities are urged to study manufacturers' recommendations and site conditions.

Joining Protective Coverings - Insert a new roll of material into an anchor slot, as with upslope ends. Overlap the end of the previous roll a minimum of 12 inches, and staple across the end of the roll just below the anchor slot and across the material every 12 inches.

Terminal End - At the point at which the material is discontinued, or at which time the protective covering meets a structure of some type, fold 4 inches of the material underneath and staple every 12 inches (minimum).

At bottom of slopes - Lead net out onto a level area before anchoring. Turn ends under 4 inches, and staple across end every 12 inches.

Final Check - These installation techniques must be adhered to:

1. Protective blanket is in uniform contact with the soil.

2. All lap joints are secure.

3. All staples are driven flush with the ground.

4. All disturbed areas have been seeded.

TREATMENT-2: SOIL STABILIZATION MATTING
(Allowable velocity range after vegetative establishment: 0 - 10 f.p.s.)

Materials

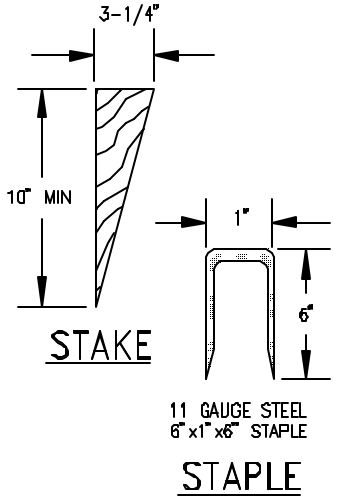
Matting - The majority of these products provide a three dimensional geomatrix of nylon, polyethylene, or randomly oriented monofilaments, forming a mat. These products contain ultra violet (UV) inhibiting stabilizers, added to the compounds to ensure endurance and provide "permanent root reinforcement."

The three dimensional feature creates an open space which is allowed to fill with soil. The roots of the grass plant become established within the mat itself, forming a synergistic root and mat system. As the grass becomes established, the two actually "reinforce" each other, preventing movement or damage to the soil. Allowable velocities are increased considerably over natural turf stands.

Selection of the appropriate matting materials along with proper installation become critical factors in the success of this practice. VDOT's "Approved Products List" can be a real asset in the selection process. Consultation with the supplier or the manufacturer and thorough evaluation of performance data to ensure proper selection of a soil stabilization matting are also essential. Although many manufacturers claim their products may inhibit erosion associated with channel velocities of up to 20 ft./sec., it is recommended that any velocities that exceed 10 ft./sec. be properly protected with some form of structural lining (see Std. & Spec. 3.17, STORMWATER CONVEYANCE CHANNEL).

Staples - Staples or anchoring methods and recommendations vary by manufacturers. The expectation of high velocities should dictate the use of more substantial anchoring. Some of the typically recommended stakes, staples and pins are depicted in Plate 3.36-3

STAKES, STAPLES, & PINS FOR INSTALLATION OF TREATMENT – 2 SOIL STABILIZATION MATTING



1) 1x4 TRIANGULAR SURVEY STAKE – MINIMUM 10" IN LENGTH. PLACEMENT OF THE STAKE ACROSS THE FLOW OF THE WATER IS THOUGHT TO PROVIDE A "PINBALL EFFECT" TO HELP SLOW THE VELOCITY.

2) 11 GAUGE STEEL – MINIMUM 1" WIDE BY 6" IN LENGTH STEEL STAPLE – 2"x8" STAPLE MAY BE REQUIRED IN CERTAIN SOIL CONDITIONS.

3) STEEL PINS – 3/16 DIAMETER STEEL PIN BY 18" IN LENGTH WITH A 2" DIAMETER WASHER ON TOP. (SEE ILLUSTRATION)

SOURCE: PRODUCT LITERATURE FROM GREENSTREAK, INC. PLATE: 3.36–3

Installation Requirements

Site Preparation - After site has been shaped and graded to approved design, prepare a friable seedbed relatively free from clods and rocks more than 1 inch in diameter, and any foreign material that will prevent contact of the soil stabilization mat with the soil surface. If necessary, redirect any runoff away from the ditch or slope during installation.

Planting - Lime, fertilize and seed in accordance with MS #1 and the approved plan, paying special attention to the plant selection that may have been chosen for the matted area. If the area has been seeded prior to installing the mat, make sure and reseed all areas disturbed during installation.

Mulching - Mulch (normally straw) should be applied following installation of **Treatment-2** at rates noted in Std. & Spec. 3.35, MULCHING.

Laying and Securing - See Plates 3.36-4, 3.36-5 and 3.36-6. Similar to installing **Treatment-1**, but Plan Approving Authority's requirements or manufacturer's recommendations must be followed as detailed. The key to achieving desired performance is dependent upon proper installation.

Check Slots - See Plate 3.36-4. Matting manufacturers vary significantly in their check slot requirements. Similar to the installation of **Treatment-1**, a check slot may be required when laying **Treatment-2** to "correct" the flow of water if it has the potential to undermine the matting. Most authorities (including VDOT) require that the sides of the matting also be entrenched, creating a slope shelf for the material to rest on, preventing water from entering under the mat on the sides.

Securing the Material and Joining Mats - Again, product specifications vary - upstream and downstream terminal slots, new roll overlaps and multiple width installations differ by various products and manufacturers.

Final Check - These installation techniques must be adhered to:

1. Soil stabilization mat is in uniform contact with the soil.

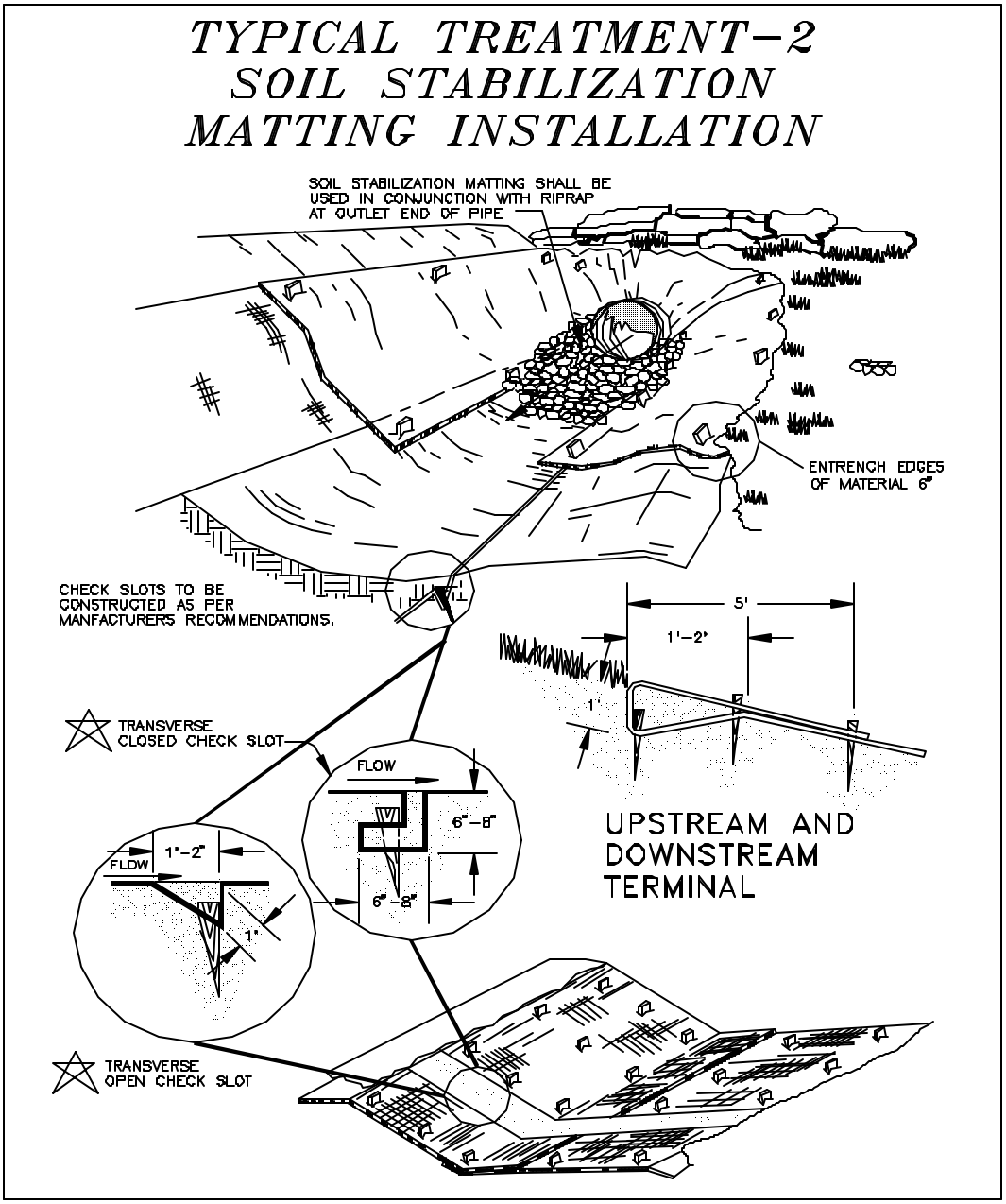
2. All required slots and lapped joints are in place.

3. The material is properly anchored.

4. All disturbed areas are seeded.

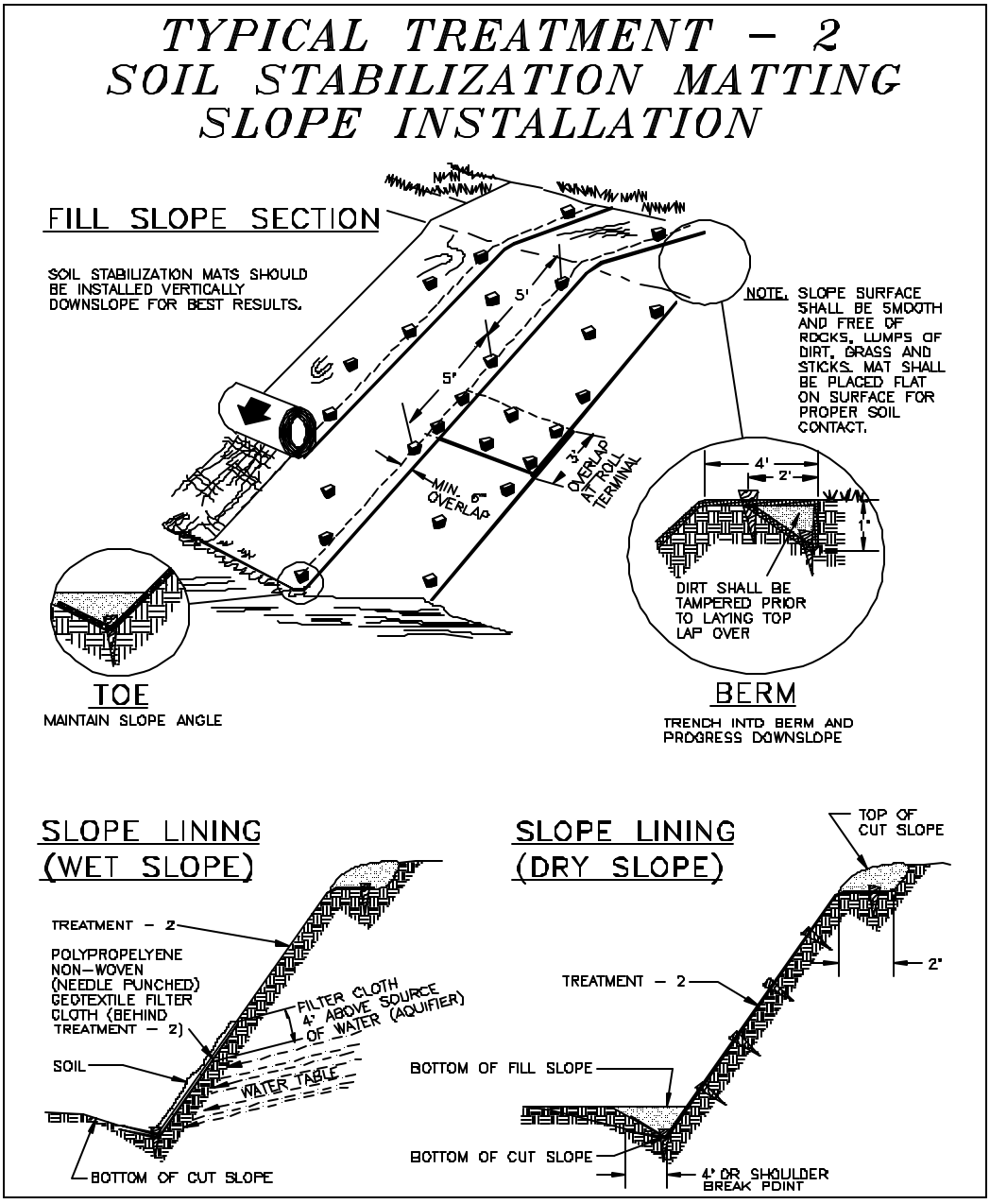
Maintenance

All soil stabilization blankets and matting should be inspected periodically following installation, particularly after rainstorms to check for erosion and undermining. Any dislocation or failure should be repaired immediately. If washouts or breakage occurs, re-install the material after repairing damage to the slope or ditch. Continue to monitor these areas until which time they become permanently stabilized; at that time an annual inspection should be adequate.



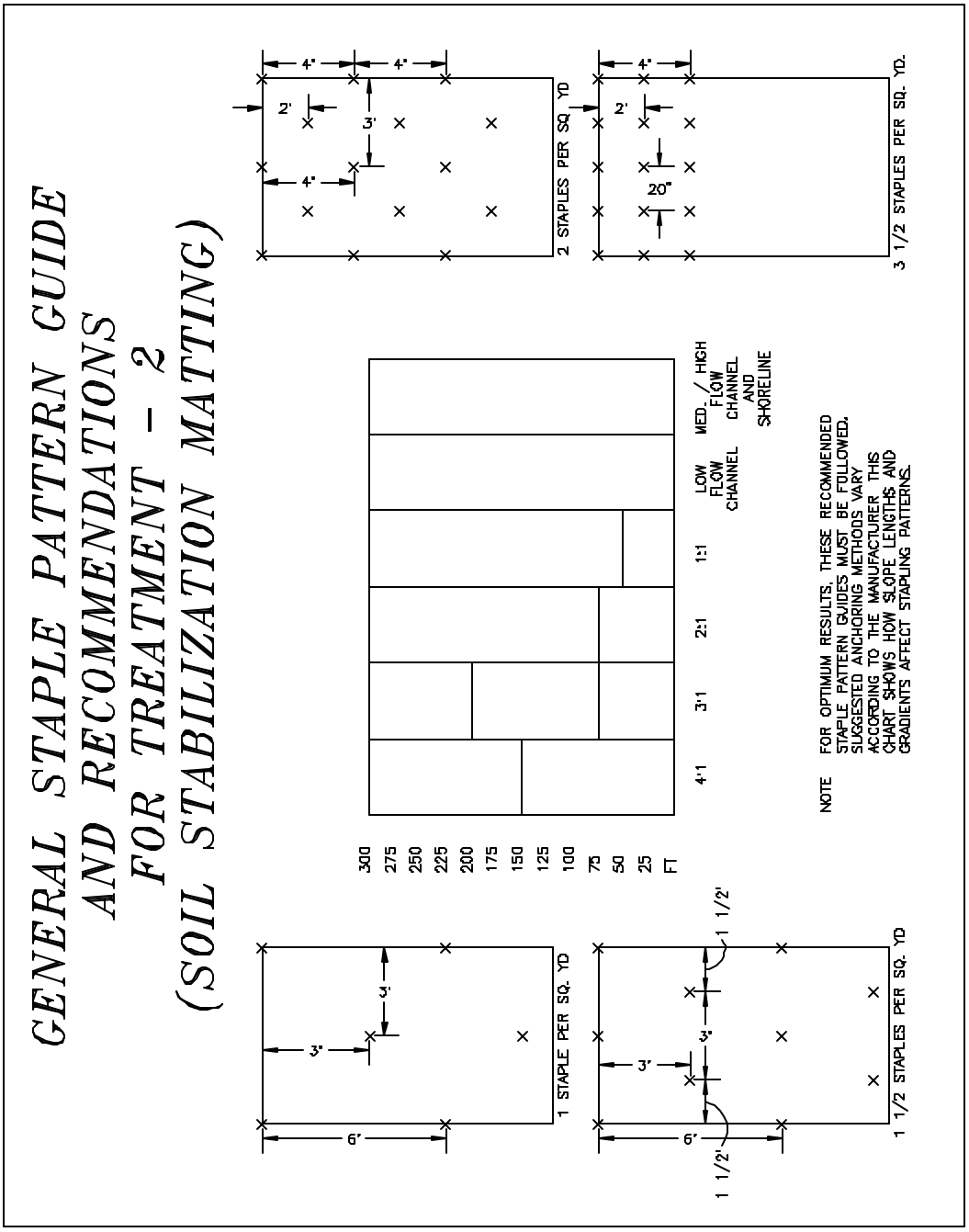
SOURCE: VDOT ROAD AND BRIDGE STANDARDS PLATE: 3.36-4

TYPICAL TREATMENT – 2
SOIL STABILIZATION MATTING
SLOPE INSTALLATION



SOURCE: VDOT ROAD AND BRIDGE STANDARDS PLATE: 3.36–5

SOIL STABIL. BLANKETS/MATTING



SOURCE: NORTH AMERICAN GREEN INSTALLATION GUIDE PLATE: 3.36-6